APPENDIX 5: DEPARTMENT OF FISH AND GAME (CDFG)

North Coast Watershed Assessment Program

Gualala River Watershed Synthesis Report

Appendix

Assessment of Anadromous Salmonids and Stream Habitat Conditions

Of The Gualala River Basin

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Gualala Estuary, Gualala, California

Upslope area of Tomb s Creek, Kings Ridge, Gualala Watershed, California

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SUMMARY

The Department of Fish and Game's (CDFG) role in the North Coast Watershed Assessment Program (NCWAP) was to examine the historic and current fisheries and stream data from the Gualala River. A main component of this Gualala River Synthesis Report was the analysis of habitat conditions in the river to identify factors that may limit anadromous salmonid populations. Historic and current fisheries and instream habitat information were compiled and verified, data gaps were identified and data collected in an attempt to fill the gaps.

Salmonid population data is limited for the Gualala Watershed. Anecdotal evidence provides a convincing case that coho salmon and steelhead trout populations on the Gualala River were large and experienced a decline prior to the 1960s. Thirty years of extensive planting of coho occurred in an attempt to reestablish a viable population. In 2001, the Coho Salmon Status Report found coho salmon absent from their historic streams and possibly extirpated from the Basin. In September 2002, a few coho salmon young-of-the–year were observed in tributaries of the North Fork Subbasin. Insufficient data existed to assess the current steelhead trout population, although it is likely that it was also depressed in the 1960s. Current electrofishing data showed that the steelhead trout distribution has not changed since the 1960s.

Over 100 miles of habitat inventory surveys were conducted on 18 streams in 2001. This provided data for the Ecological Management Decision Support (EMDS) reach model. The model was one of the tools used to conduct the limiting factors analysis, determining the suitability of the canopy density, pool quality, pool depth, pool shelter, and embeddedness for salmonid production and health. Unsuitable conditions were identified as limiting factors. Fully suitable conditions were identified as potential refugia. The most common limiting factors were lack of pool shelter, shallow pool depth and insufficient canopy cover.

Habitat inventory data, EMDS, the biologist's professional judgment, and local expertise were used to identify limiting factors, areas of potential refugia, and restoration priorities. CDFG, California Department of Forestry, and the California Geological Survey co-developed a map showing the potential restoration sites based upon integrated data.

INTRODUCTION

GUALALA RIVER BASIN OVERVIEW

The Gualala River drains 298 square miles along the coast of southern Mendocino and northern Sonoma Counties. At the mouth, the river widens into a coastal lagoon/estuary and then enters the Pacific Ocean near the town of Gualala, CA. Highway 1 bridges the south and north sides of the coastal lagoon estuary. Elevations, in the Gualala basin, vary from sea level to 2,602 feet. The terrain becomes mountainous directly inland of the coastal bluffs. The San Andreas and Tombs Creek Faults are the dominant natural forces shaping the basin. The California Geological Survey provided a complete description of the geology of the basin (Appendix 2 of the Gualala Synthesis Report). Climate varies from cool fog influenced weather near the coast with seasonal temperatures ranging between 40° to 60°F degrees to more extreme interior basin weather with seasonal temperatures ranging from 0° to 90°F. Rainfall varies throughout the basin from 33 to 63 inches annually. The California Department of Water Resources provided a complete description of the hydrology of the basin (Appendix 1 of the Gualala Synthesis Report). There are two "post office" towns in the Gualala basin: one is the town of Annapolis, CA and the other is the town of Gualala, CA. The town of Gualala, CA is the largest town in the watershed with a population of 1,806. The populations of the area seasonally increase due to tourism on weekends and in summer months.

Ninety-five percent of the watershed is held in private ownership. This ownership consists of private timberlands, ranches, vineyards, and private residences. Coastal redwood and Douglas fir dominate the northwestern and southwestern areas with a few isolated pockets in the central portions where the summer coastal fog bank is able to infiltrate. Oak-woodland and grassland cover most of the slopes in the interior basin. Current land use includes timber harvesting, grazing, private hunting clubs, rural subdivisions, vineyards, one private campground, and two Sonoma County campgrounds. Historic land use was dominated by timber harvesting, farming, and grazing. In 1956, the California Department of Fish and Game (CDFG) states that the Gualala River had been damaged more that the average stream on the north coast, adverse logging conditions and past improper practices had done considerable damage to the headwaters, primarily in the form of old logjams, debris and siltation (Fisher 1956). The California Department of Forestry and Fire Protection (CDF) provided the complete land use of the basin (Appendix 4, Gualala Synthesis Report).

Calwaters 2.2 divides the Gualala River watershed into five subbasins. These are the North Fork, Rockpile Creek, Buckeye Creek, Wheatfield Fork, and the South Fork-Mainstem. To reflect the differences in topography and habitat, the Wheatfield Fork is further divided into the Lower Wheatfield, Walter's Ridge and Hedgepeth Lake areas.

Anadromous Pacific salmonids spend over half their life in the marine environment, which is generally beyond human control other than to regulate harvest. Recent studies have implicated the estuarine and coastal phase of the salmon life cycle as being of equal importance to the freshwater phase in determining production. Evaluation of the freshwater phase of salmon has yielded a better understanding of the factors limiting production in this environment; however, a comparable understanding in the marine environment is lacking (Brodeur et al. 2000).

Several factors contribute to the decline in salmon abundance off the Pacific coast of North America: over fishing, freshwater habitat degradation, loss of genetic integrity due to interactions of native and hatchery fish, and climatic influences, the latter particularly during the marine phase of the life cycle (Moyle, 1994). Of these factors, the goal of the North Coast Watershed Assessment Program is to assess the suitability of the freshwater habitat for salmonid health.

Salmonids are dependant upon a high quality freshwater environment at the beginning and end of their life cycles. They thrive or perish depending upon the availability of cool, clean water, free access to migrate up and down their natal streams, clean gravel for successful spawning, adequate food supply, and protective cover to escape predators and to ambush prey. These life requirements are provided by diverse and complex instream habitats as the fish progress through their lives. The survival of salmonids can be impacted if any of these elements are missing or in poor condition. The purpose of this report was to identify and evaluate these life requirement conditions. This was to be done spatially and temporally at the stream reach and watershed levels. These conditions comprise the factors that support or limit salmonid stock production (Attachments A and B). Although not usually optimal, all the important factors for survival need to be within in a suitable range throughout the life of the fish. The particular mix of environmental factors sets the carrying (rearing) capacity of the stream. To alter one or more of these factors can adversely affect this capacity. The importance of specific factors in setting carrying capacity may change with life stage of the fish and season of the year (Bjorn and Reiser 1991).

Through the course of the year climatic conditions, watershed hydrologic responses, and erosion events interact to shape freshwater salmonid habitats. Another factor is the watershed's flora; the structure and diversity of the plant community influence a stream's productivity. The watersheds vegetative cover supplies shade, humidity and nutrients to the stream. In the absence of a major disturbance, these processes produce small continuous changes in variability and diversity, against which the resource manager must judge the modifications produced by nature and human activity. Major disruption of these interactions can drastically alter habitat conditions (Swanston 1991). The results of a major disruption, which can be created over time by many smaller disruptions, can drastically alter instream habitat conditions and the aquatic communities that depend upon them. It is important to understand the critical, dependent relationships of salmon and steelhead trout with their natal streams during their freshwater life phases. Additionally significant is an understanding of the streams' dependency upon the watersheds and the watershed's process' in which they are nested.

Protection and maintenance of high-quality fish habitats should be among the goals of all resource managers. Preservation of good existing habitats should have high priority. Many streams have been damaged and must be repaired. Catastrophic natural processes that occlude spawning gravels can reduce stream productivity or block access by fish. However, many stream problems, especially in western North America, have been caused by poor resource management practices of the past. Enough now is known about the habitat requirements of salmonids and about good management practices that further habitat degradation should be prevented, and habitat rehabilitation and enhancement programs can go forward successfully (Meehan 1991).

In general, natural disruption regimes do not affect larger watersheds, like the 298 square mile Gualala, in their entirety at any given time. Rather, they rotate episodically across the entire mosaic of their smaller subbasin, watershed, and sub-watershed components over long periods. This creates a shifting mosaic of habitat conditions over the larger watershed (Reice 1994).

Human disturbances, although individually small in comparison to natural events, usually are spatially distributed widely across basin level watersheds (Reeves et al. 1995). This occurs because market driven land uses tend to function in temporal waves, like the California Gold Rush or the post-WWII logging boom. The intense human land use of the last century, combined with the energy of two mid-century record floods on the North Coast, created stream habitat impacts at the basin and regional scales. The result has overlain the natural disturbance regime and depressed stream habitat conditions across most of the North Coast region (Gualala Synthesis Report, Appendix II 2002).One task of the CDFG as part of the North Coast Watershed Assessment Program was an analysis of instream habitat conditions to identify factors that may limit anadromous salmonids. Factors considered limiting to anadromous salmonid populations in their freshwater habitat include insufficient stream flow, lack of deep pools, inadequate amounts of large wood, deficient instream cover and/or poor shade canopy. Other limiting factors are high water temperature, excessive sediment, and turbidity. Restoration recommendations were made after identifying habitat deficiencies.

Another task was to identify refugia, areas that provide shelter or protection during times of danger or distress and locations and areas of high quality habitat that support populations limited to fragments of their former geographic range.

OBJECTIVES

The Department of Fish and Game's role in the North Coast Watershed Assessment Program focused on the historic and current fisheries and instream data. Limited current fisheries and instream data existed prior to this program.

In preparing the Fisheries Status and Fish Habitat Relationship sections there were six objectives:
1) Compile, verify and rate the quality of the existing data from available sources; 2) Identify data gaps;
3) Collect additional data to help fill data gaps; 4) Analyze data when possible; 5) Report limiting factors and identify potential refugia in terms of suitability for salmonid production; and 6) Recommend restoration priorities where data existed. CDFG, the California Geological Survey and the California Department of Forestry co-developed a Potential Restoration Map.

METHODS

INVESTIGATION OF EXISTING DATA

All existing available data and anecdotal information pertaining to salmonids and the instream habitat for the Gualala River and its tributaries were collected. The data and information were inventoried and rated for quality, both in terms of collection methods and source. Instream habitat gaps were identified, mapped and matched with corresponding land parcels. Where data gaps existed, access was requested from landowners to conduct biological surveys.

DATA COLLECTION

Habitat inventory and electrofishing surveys were conducted based on the need to fill instream habitat data gaps and salmonid distribution. Surveys were limited by landowner access. Habitat inventories and biological data were collected following the protocol presented in the *California Salmon Stream Habitat Restoration Manual* (Flosi et al. 1998). Two person crews trained by CDFG in standardized habitat inventory methods conducted physical habitat inventories, June through November 2001. The Rosgen channel typing method was used to determine channel types and stratify the streams into reaches. The habitat type and stream length were determined for all habitat units within a survey reach.

During basin level habitat typing, full sampling of each habitat unit requires recording all characteristics of each habitat unit as per the "Instructions for completing the Habitat Inventory Data Form" (Part III). It was determined that similar stream descriptive detail could be accomplished with a sampling level of approximately 10 percent (Flosi et. al 1998). When sampling 10 percent of the units, all habitat types were measured when encountered for the first time. Thereafter, approximately 10 percent of the habitat units were randomly selected for measurement of all the physical parameters. The habitat unit type, mean length, mean width, mean depth, and maximum depth were determined for the other 90 percent of the units. Pool habitat types were also measured for instream cover and embeddedness. The physical parameters measured include flow, channel type, temperature, habitat type, embeddedness, shelter/cover rating, substrate composition, canopy cover, bank composition, and stream bank vegetation. Streams were surveyed until the end of anadromy was determined. The presence of physical barriers to fish passage, a steep gradient greater than 8-10% or a dry section of the stream 1000 feet or more were used to determine the end of anadromy.

The habitat inventory survey data were compiled to show instream conditions at the time the survey were conducted. Canopy cover, embeddedness, dominant substrate, pool depth, pool frequency, and pool shelter cover results were presented for each of the streams surveyed by subbasin. Data for each of the aforementioned parameters were averaged over the entire stream length surveyed. Habitat deficiencies were identified when stream conditions did not meet target values. Habitat deficiencies were tallied for each subbasin. Although the data were collected with very different methodology, the streams surveyed in 1964 and then habitat inventoried in 1995, 1999 or 2001 were compared to indicate changes of instream habitat conditions.

Salmonid presence and distribution were obtained using the Modified Ten Pool Protocol (Attachment D) with Smith Root Model 12 backpack electrofishing units. Electrofishing was conducted on eight tributaries. The Ten Pool Protocol was designed to detect the presence of coho salmon and is not a valid method for calculating density or age class structure of any species (pers. comm. L. Preston).

ECOLOGICAL MANAGEMENT DECISION SUPPORT (EMDS)

The EMDS model compared the habitat inventory survey data to a set of habitat quality reference conditions, which were determined from empirical studies of naturally functioning channels, expert opinion, and peer reviewed literature. For each component, the model relates values to relative habitat quality regarding parameters of salmonid suitability health and productivity. EMDS model then rated each habitat component with a suitability score between -1 and +1. The scores indicated a degree of suitability between high and low with positive scores associated with suitable conditions and negative scores associated with unsuitable conditions. For evaluation at the stream, subbasin, and basin scale, the EMDS model accounted for stream survey length. Scores from long reaches carried more weight than those from short reaches. Thus, the habitat deficiencies shown from the habitat inventory data may vary from the EMDS model outputs. The equation for calculating weighted average by stream reach in order to identify stream, subbasin and basin scale limiting factors is: Weighted Average by Stream Reach = ? *LiSi/Li*, Where: *Li* = reach length, and *Si* = EMDS score by reach. If the EMDS score from a certain habitat component did not fit within the suitable range of the reference values, it was considered a limiting factor for salmonid health and productivity.

LIMITING FACTORS ANALYSIS

The Limiting Factor Analysis (LFA) was a simplified approach to identify ecosystem components that constrain habitat capacity, fish production, and species life history diversity (Mobrand et al 1997). The Gualala Basin LFA was developed for assessing coarse scale stream habitat components and may not satisfy the need for site-specific analysis at an individual landowner scale.

Components essential to the health of anadromous fish populations in freshwater habitat include canopy cover, embeddedness, pool depth, pool frequency, pool quality, and shelter/cover. Unsuitable components were associated with their effects on salmonid health and productivity. Unsuitable canopy cover was associated with increases in water temperature; unsuitable embeddedness was related to poor spawning substrate; unsuitable pool depth and frequency were associated with poor summer conditions; unsuitable shelter was related to decreased escape cover, which relates to increased predation and decreased high flow refuge.

The analysis of data collected during habitat inventory surveys taken in 1999 and 2001 and the EMDS outputs identified unsuitable key components for each stream surveyed. After identifying the potential limiting factors, the factors were ranked according to the habitat deficiencies that were the most detrimental. Higher rankings indicated greater unsuitability. The biologist's professional judgment took precedence where partial surveys were conducted or when data and observations inconsistencies existed. Last, recommendations were selected and prioritized for potential habitat improvement activities.

RESTORATION RECCOMENDATIONS

Restoration priorities were compiled in order to assist in identifying future improvement projects and watershed management strategies. These restoration recommendations were based upon habitat inventory surveys conducted in 1995, 1999, and 2001, landowner and local expertise, analysis of field notes, and professional judgment. CDFG, CDF and CGS further developed a map showing the potential restoration sites and factors limiting salmonid health and production (Gualala Synthesis Report).

In general, the recommendations that involve erosion and sediment reduction by treating roads, failing stream banks, and riparian corridor improvements precede the instream recommendations in reaches that demonstrate disturbance levels associated with watersheds in current stress. Instream improvement recommendations are usually a high priority in streams that reflect watersheds in recovery or in good health. Project recommendations can be made in concurrence if conditions warrant. Fish passage problems, especially in situations where favorable stream reaches are blocked by human-caused features (e.g., culvert, dam, or water diversion), are usually a high treatment priority in any stream. Biological recommendations were made based upon the propensity for benefit to multiple or single fishery stocks or species.

POTENTIAL REFUGIA

Professional judgment, landowner and local expertise, analysis of field notes, habitat inventory survey results, and EMDS scores, determined potential refugia. If a habitat component received a suitable ranking from the EMDS model, it was cross-referenced to the survey results from that particular stream and to field notes taken during that survey. The components identified as potential refugia were identified and ranked according to their suitability to support salmonid health and productivity.

RESULTS OF FISH DATA AND ANALYSIS

Compared to other North Coast watersheds, significantly less data collection and research has been devoted to the Gualala Basin. This is probably related to the fact that 95% of the watershed is privately owned, making landowner access a necessity to conduct fieldwork. Attachment A inventories the available data rated of high quality and was used to identify data gaps and includes data collected by CDFG through 2001. It does not include the coho salmon young-of-the-year observed in the North Fork Subbasin in September 2002.

FISH HISTORY AND STATUS

Current fish species of the Gualala River Watershed include coho (silver) salmon (H. Alden, pers comm. 2002; CDFG unpub 2002), steelhead trout, pacific lamprey, roach, coastrange sculpin, prickly sculpin, riffle sculpin (R. Kaye, pers comm. 2002) and three-spine stickleback. Above impassable barriers, resident populations of rainbow trout exist (Cox 1989). Species inhabiting the coastal lagoon/estuary include starry flounder, staghorn sculpin (Brown 1986) and Pacific herring (R. Kaye, pers comm. 2002) (Table 1).

Historic anecdotal accounts cite eulachon in the estuary and Sacramento sucker in the main stems of both Buckeye Creek and Wheatfield Fork (Higgins 1997). Snyder (1907) did not observe Sacramento suckers on the Wheatfield Fork. Juvenile Chinook (king) salmon specimens were caught prior to 1945 indicating that they were present at that time (D. Fong pers. comm.). It is unknown if eulachon, Sacramento sucker or Chinook salmon inhabit the basin today.

Table 1: Current Fish Species in the Gualala River Watershed, CA.

Common Name	Scientific Name
Anadromous	
Coho salmon	*Oncorhynchus kisutch*
Steelhead trout	*Oncorhynchus mykiss*
Pacific lamprey	*Lampetra tridentata*
Freshwater	
Gualala Roach	*Lavinia symmetricus parvipinnis*
Coast range sculpin	*Cottus aleuticus*
Prickly sculpin	*Cottus asper*
Riffle sculpin	*Cottus gulosus*
Threespine stickleback	*Gasterosteus aculeatus*
Marine or Estuarine	
Surf smelt	*Hypomesus pretiosus*
Pacific herring	*Clupea pallasii*
Staghorn sculpin	*Leptocottus armatus*
Starry flounder	*Platicthys stellatus*

SALMONID POPULATION

In assessing salmonid populations, data is collected through various methods: spawning surveys, mark and recapture, creel census, juvenile trapping and electrofishing. The data is then analyzed to arrive at a population estimate backed by statistical confidence intervals. Accurate and credible population estimates include some enumeration of the whole or selected portion of the population. Population estimates made without data or by relating one watershed's precipitation, latitude and longitude, and comparing it with better-studied streams of similar size are not accurate or credible and should not be used to establish trends. NMFS (2001) asserts that "trend analysis should be conducted at the same location using consistent methods, so that at least two complete life cycles can be used to indicate the size of a population".

Salmonid population data is very limited for the Gualala River Watershed (Table 2). Anecdotal evidence provides a convincing case that coho salmon and steelhead trout populations on the Gualala River were large and experienced a decline prior to the 1960s. After World War II ended in 1945, the Gualala River became a popular place to fish for coho salmon, steelhead trout, and possibly Chinook salmon, based on the 200-300% increase in fishing pressure (Taft 1946). The increased fishing pressure indicated that the coho salmon and steelhead trout populations were large in the 1940s. In 1952, electrofishing below the confluence of the North Fork revealed that the fish captured showed a healthy condition (Kimsey 1952). Bruer (1953) wrote that there were "millions of young steelhead trout and coho salmon in the Gualala Watershed".

Neither accurate nor credible coho salmon population estimates were conducted, all available data indicates that the coho salmon population began to decline prior to the 1960s. In 1956, adverse logging conditions and past improper practices had done considerable damage to the headwaters (Fisher 1956). This was primarily in the form of old logjams, debris and siltation. CDFG stream surveys conducted in 1964 recommended stocking coho salmon to reestablish a viable self-supporting run in streams with pre-existing populations. This management recommendation indicates that the population had decreased from the large, fishable, population of the 1940s toward the need to reestablish a viable population in the 1960s.

Coho salmon stocking began in 1969. Coho salmon fingerlings were were planted close to the time when the CDFG conducted its 1970s stream surveys, which occurred throughout the watershed. Coho salmon were observed in most of the tributaries surveyed, however it is unknown whether they were native or hatchery stock. Even with extensive planting, coho salmon have not been observed in their historic streams except in the North Fork Subbasin. Electrofishing data from 2001 indicated that coho salmon were absent and possibly extirpated from the Gualala Basin (Coho Salmon Status Review 2001). In September 2002, coho young-of-the-year were observed in the North Fork Subbasin on McGann Gulch Creek, (R. Dingman, Gualala River Steelhead Project, personal communication), and in Dry Creek (H. Alden, Gualala Redwoods, Inc. personal communication), both tributaries to the North Fork. Coho young-of-the-year were also observed on the Little North Fork and Doty Creek during electrofishing surveys (CDFG 2002) (Table 3).

Starting in the 1940s and continuing today, steelhead trout have been actively fished on the Gualala River. In 1945, a summer juvenile steelhead trout closure was ordered to protect juvenile salmonids. This closure remained in effect until 1982. Bruer (1953) states that the Gualala River was a prime steelhead trout and coho salmon stream and should be used to provide recreation for hundreds of anglers. By 1956, the Gualala River continued to sustain a good steelhead trout population despite the damage to the headwaters. Fishing pressure continued to increase through the early 1970s. In spite of the increased pressure, the steelhead trout catch was less than in the 1950s, probably due to smaller steelhead trout populations. During the 1970s, CDFG efforts focused on enhancing the sport fishing on the Gualala River. CDFG began planting steelhead trout in 1970. Using mark and recapture techniques on the Gualala River, two credible steelhead trout population estimates were conducted in 1975-76 and 1976-77 (Boydstun 1976a; Boydstun 1976b). The population was estimated at 7,608 in 1975-76 and 4,324 in 1976-77, with a 95% confidence interval. From 1983 to 1989, 301,770 steelhead trout were planted in the Gualala River. In 1989, a 75 foot section of Fuller Creek, a tributary to the Wheatfield Fork, was sampled using three-pass depletion electrofishing, and a population estimate of 62 juvenile steelhead trout was calculated (Cox 1989). From 1993-1997 and 1999-2000, the Gualala River Steelhead Project rescued 37,030 steelhead trout, of which 20,328 were released. Steelhead trout young-of-the-year and older were observed in all ten of the tributaries electrofished in September 2001. During the 2001 fishing season, both local anglers and long time Gualala CDFG Warden Ken Hofer (CDFG, pers. comm.) reported that the steelhead trout run was the largest seen in over seven years.

Table 2: Coho salmon and steelhead trout data summary by decade, 1945-2002, Gualala River Watershed, CA.

Decade	Coho Salmon	Steelhead Trout
1940s	A.C. Taft, chief of the Bureau of Fish Conservation, notes that the fishing pressure on the Gualala River increased 200-300% immediately after World War II ended in 1945.	A.C. Taft, chief of the Bureau of Fish Conservation, requests that the entire Gualala River and its tributaries be closed to fishing for small and immature steelhead trout and salmon. Upon his recommendation, the summer closure began in 1945 and remained until 1982.
1950s	In 1952, electrofishing below the confluence of the North Fork revealed that the length frequencies of the fish removed show a healthy condition (Kimsey 1952). Bruer (1953) writes that there are millions of young steelhead trout and coho salmon in the Gualala watershed. In 1956, Fisher, cites that the adverse logging conditions and past improper practices had done considerable damage to the headwaters. This is primarily in the form of old logjams, debris and siltation. By 1959, the summer opening was not worthwhile for a person who must travel any distance (Kastner 1959).	During December 1954 through February of 1955, creel surveys were conducted to determine the quality of the steelhead trout fishery on the Gualala River. Five hundred and seven fish were checked. A total catch estimate of 1,352 fish for the season was extrapolated with data from a use count. In 1956, Fisher, concludes that the Gualala remained one of the better Region III steelhead trout streams. It appears to sustain a good steelhead trout population despite the poor environmental conditions over a considerable portion of its headwaters. He speculates that unaffected tributary streams must provide good spawning conditions.
1960s	Stream surveys were conducted in 1964. The species presence and relative abundance of salmonids were estimated from observations recorded while walking upstream along the banks. These surveys had no quantitative basis from which to estimate populations. Where coho salmon were observed during these stream surveys the management recommendations include "possible planting to re-establish a self supporting run". Based on the Department of Fish and Game's management prescriptions of the time, this recommendation likely indicates that the native coho salmon populations were not self-sustaining prior to 1964. CDFG reports population estimates of 4000 coho salmon in 1965. This population estimate is made without any supporting data thus is not reliable. The estimate is ranked "C without data" the lowest quality rating designated by the California Fish and Wildlife Plan, Volume III. In 1969, 90,000 coho salmon were planted .	Steelhead trout were present during stream surveys in 1964. Only one creel census survey was conducted on January 24, 1962. The result of the survey shows 11 steelhead trout caught by 18 anglers. Total angler hours are 56.5 resulting in a catch-per-unit-effort of 0.20 fish/hour. CDFG reports steelhead trout population estimates of 16,000 in 1965. This population estimate is made without any supporting data, thus is not reliable. The estimate is ranked "C without data", the lowest quality rating designated by the California Fish and Wildlife Plan, Volume III.

Decade	Coho Salmon	Steelhead Trout
1970s	A 1970's U.S. Bureau of Reclamation study of the Gualala River states that 75 miles of habitat is available to coho salmon in the Gualala Basin (U.S. BOR 1974). The "available habitat" estimate is made by relating the Gualala watershed with better-studied streams of similar size and characteristics. This estimate is not substantiated through actual observation. Hatchery plants of coho salmon; 1970, *30,000*; 1971, *30,000*; 1972, *15,000*; 1973, *20,000*; 1975, *10,000*. Total number of coho salmon planted in the 70's, *105,000*. Some streams are surveyed in 1970 with methods similar to those conducted in 1964. It is not known how many of the coho salmon observed during these stream surveys are from the 120,000 planted in 1969-1970. No mention of marked or unmarked hatchery coho salmon are found in the planting records or stream reports In the mid-1970s, the CDFG's Coastal Steelhead Project was conducted, in part, on the Gualala River, California. In 1972-73, the creel censuses begin in November and result in high counts of coho salmon catches with 831 coho salmon counted. All other years, the creel censuses begin in December after the peak of the coho salmon run has passed. In the 1973-74 survey fifty -two coho salmon are counted, in the 1974-75 survey ten coho salmon are counted, in the 1975-76 survey ten coho salmon are counted and in the 1976-77 survey no coho salmon are counted. California Drought	A 1970's U.S. Bureau of Reclamation study states that 178 miles of habitat is available to steelhead trout in the Gualala Basin (U.S. BOR 1974). Some streams were surveyed in 1970 with methods similar to those conducted in 1964. The steelhead trout observed during these stream surveys are assumed native as planting did not occur until 1972. The steelhead trout planted during the 1970's are 12,750 in 1972; 20,300 in 1973; 15,600 in 1974; 24,600 in 1975; and 10,070 in 1976, a total of 83,320. The Mad River Hatchery yearling steelhead trout were marked by a fin-clip. CDFG reports cite origins of brood stocks as Mad River Hatchery, South Fork Eel River and San Lorenzo River. In 1972-73, L.B. Boydstun, CDFG fish biologist, estimates that the fishing effort on the Gualala River has probably increased over 60% since the early 1950's, when the only other creel censuses were conducted. In spite of the increased pressure during the 1972-73 season, the steelhead trout catch is around 25% of what it was during the 1953-54 and 1954-55 seasons. He attributes the poor catch to smaller populations. During the 1972-73 creel census, 288 steelhead trout are caught. No recognizable hatchery fish from the spring planting in 1972 are observed. During 1975-76 and 1976-77, steelhead trout population estimates were made as part of a five-year study. The study utilized creel census, use counts, adult tagging, and downstream migrant trapping in conjunction with the planting of steelhead trout. The goal of the project was to estimate winter adult steelhead trout populations, estimate angler harvest rates and evaluate the contribution of hatchery steelhead trout to the fishery. This program focused on enhancing the Gualala River as a sport-fishing stream. The steelhead trout population estimate is 7,608 in 1975-76 and 4,324 in 1976-77, with 95% confidence intervals. Two years of data is not sufficient to establish a population trend. Adult steelhead trout population data does not exist after 1977. Harvest estimates were made at the end of the fishing seasons for each of the five years studied. In the 1972-73 season, 288 fish are surveyed. In 1973-74, 1682 steelhead trout are marked for possible recapture. In 1974-75, there are 793 fish counted and in 1975-76, there are 1418 fish counted. Eleven percent of the fish surveyed in 1975-76 are hatchery fish, and a 20.3 % harvest rate is calculated. In the 1976-77 season, there is a 19.8% harvest rate with no hatchery fish recorded. No creel census results are documented from the 76-77 season. The surveys typically began in December. The 1972-73 survey began in November.
1980s	From 1985-1989, 102,000 coho salmon are planted.	From 1983-89, 301,770 steelhead trout were planted in the Gualala River. The year totals of steelhead trout planted are; 12,500 in 1983; 13,400 in 1984; 9,700 in 1985; 57,450 in 1986; 26,250 in 1987; 108,750 in 1988 and; 73,700 in 1989. Bag seines are employed five times during the years of 1984-1986, to sample the game and non game fishes of the Gualala River estuary. The purpose of this survey was to assess the impact of proposed water diversions on aquatic species, in general, and juvenile salmonids, in particular. On Robinson Creek, one station was three-pass electro-fished and showed a steelhead trout density of 0.85 per meter. Since electrofishing data were collected only in 1983 on Robinson Creek, insufficient data exists in which to

Decade	Coho Salmon	Steelhead Trout
		make comparisons. Three pass electrofishing data were collected on a lower and upper site in the Little North Fork in 1988 and 1989. The surveys result in an average steelhead trout density of 0.45 on the Little North Fork. In 1989, juvenile steelhead trout population on Fuller Creek (approx. 6 mile long, 3rd order stream) is estimated at 62 with a standard error of 8.599, for the length of stream sampled (75 feet). Four stations were fished with a two or three pass depletion electro-fish method. These stations are located on South Fork and Mainstem of Fuller Creek. The intent of this survey was to assess the impacts from the upstream logging. Station 4 is upstream of the falls on the South Fork, where resident rainbow trout are observed. Young-of-the-year and one year and older steelhead trout, western roach, and three-spine stickleback are found during these surveys.
1990s	Over three years, 45,000 juvenile coho salmon from the 1995-1998 brood years were planted in the Little North Fork. The juveniles were from the Noyo River Egg Collecting Station run by CDFG in Fort Bragg, CA. During snorkel surveys, Gualala Redwoods, Inc. observes coho salmon young-of-the-year on the Little North Fork, Robinson and Dry Creek in 1998 Between July 1, 1999 and June 30, 2000, spawner and electrofishing surveys were conducted on the Little North Fork Gualala River. These surveys were conducted to determine whether the planting of coho salmon during the 1996-98 periods was effective. No coho salmon were found.	In 1990, a total of 41,300 steelhead trout were planted in the Gualala River. Since1993, the Gualala River Steelhead Project rescued steelhead trout juveniles from streams in danger of drying up during the summer months. Rescued fish are kept in two Doughboy pools at the hatchery on Doty Creek, a tributary to the Little North Fork of the Gualala River. The fish are released in the North Fork Subbasin and main stem Gualala River after the first substantial winter rains increase stream flows. From 1993-1997 and 1999-2000, 37,030 steelhead trout were rescued and 20,328 were released. During 1990-93, 95, 98, 99 and 2000 three-pass electrofishing data was collected on a lower and upper site in the Little North Fork. No effort was recorded in 1990-1992. Both sites show small fluctuations in young-of–the year populations. Both sites show a slight increase in one-year-old fish from 1995-2000. Two year and older steelhead trout numbers are identical at the lower site and slightly increased at the upper site from 1998-2000. In 1995, one-pass electrofishing surveys were conducted on Fuller Creek and South Fork Fuller Creek. Young of the year, year plus and two year plus steelhead trout are observed. The results are not comparable to the 1989 survey, due to differences in sampling techniques. Gualala Redwoods, Inc. conducted snorkel surveys in 1997, 1998 and 1999. In 1997-98, one year and older steelhead trout are observed in Buckeye Creek and South Fork. In 1998, one year and older steelhead trout are observed in the Wheatfield Fork. In 1999, one year and older steelhead trout are observed in Little North Fork, Robinson Creek, North Fork and Doty Creek.
2000s	Robinson Creek and Dry Creek were surveyed in 1999, 2000, and 2001, no coho salmon were found (CDFG unpubl. data) Historical coho salmon streams listed by Brown and Moyle (1991) were electro-fished in September 2001. The method used was the modified ten-pool protocol. The streams electro-fished were North Fork, Doty Creek, South Fork, Franchini Creek, Wheatfield Fork, Haupt Creek, Tombs Creek, House Creek, Pepperwood Creek and Marshall Creek. This survey was specifically aimed at establishing coho salmon presence in the streams sampled. Coho salmon were not found in any of the streams surveyed. Coho Salmon Status Review (2001) states there are no known remaining	Between July 1, 1999 and June 30, 2000, spawner and electrofishing surveys were conducted on the Little North Fork, a tributary to the North Fork by CDFG. These surveys were conducted to determine whether the planting of coho salmon during the three-year period of 1995/96-1997/98 was effective. In 2000-2001, 7,600 and 5,450 steelhead trout were planted on the North Fork between Elk Prairie and Dry Creek. During snorkel surveys, Gualala Redwoods, Inc. observes one year and older steelhead trout on Little North Fork, Robinson, North Fork, and Dry Creek in 2000 and 2001; on the mainstem of Buckeye Creek in 2000 and

Decade	Coho Salmon	Steelhead Trout
	viable coho salmon populations in the Gualala River system. In September 2002, coho salmon young-of-the year were present on Dry Creek, a tributary of the North Fork during a snorkel survey and two sites on the Little North Fork and Doty Creek during electrofishing. Coho young-of-the-year were present on McGann Creek, rescued and released (R. Dingman, pers. comm)	2001; and on the South Fork in 2000 and 2001. February-April 2001, volunteer effort steelhead trout spawning surveys observed redds on Wheatfield Fork, Tombs Creek, Britain Creek, House Creek, and South Fork. Redds were observed on Rockpile Creek in 2001 (K. Morgan, pers. comm).

STOCKING OF COHO SALMON AND STEELHEAD TROUT

In the past, stocking of hatchery-raised salmonids was regularly employed to supplement declining stocks and/or to enhance sport-fishing quality. Coho salmon and steelhead trout were stocked on the Gualala River for both of these reasons. Coho salmon stocking began in 1969 and continued until 1999. Over the next 30 years, 347,780 hatchery coho salmon were stocked. From the 1995-1998 brood years, 45,000 were planted in the Little North Fork of the North Fork Subbasin (Fig. 1). Over the next 30 years, 347,780 hatchery coho salmon were stocked. From the 1995-1998 brood years, 45,000 were planted in the Little North Fork of the North Fork Subbasin (Fig. 1). A total of 342,000 were planted over 30 years. Steelhead trout were stocked as part of sport fishing enhancement projects. Steelhead trout stocking began in 1972 and continued until 1990. Additionally, from 1993 to the present at least 37,030 steelhead trout were rescued and raised by the Gualala River Steelhead Project, at least 20,328 steelhead trout were released, with one year of data is missing (GRSP 2000). A total of 444,530 steelhead trout were planted over 29 years (Fig. 1).

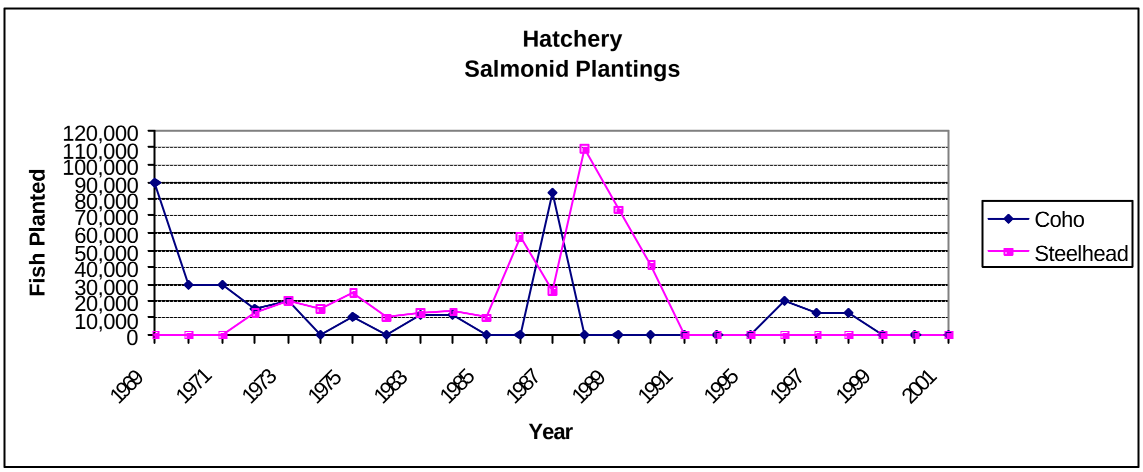

Fig. 1: Stocking records from 1969-99 for coho salmon and steelhead trout in the Gualala River Watershed, CA.

SALMONID RANGE OR DISTRIBUTION

Distribution relates to any species' given range at the time the information was collected. Changes in fish distribution result from changes in water and habitat conditions from natural and human-caused impacts, including over-harvesting, on both a localized and global scale.

The distribution of coho salmon has significantly changed over the past 32 years in the Gualala River Watershed. Coho salmon were known to be distributed in four of the five subbasins, inhabiting 10-15 tributaries (Table 3).

Table 3: Historic Coho Salmon Distribution (Brown and Moyle 1991) in the Gualala River Watershed, CA.

Subbasin	North Fork	Rockpile	Buckeye	Wheatfield Fork	Main Stem South Fork
Tributaries	North Fork Doty Creek Little North Fork	No data available or not surveyed	Franchini Creek	Wheatfield Fork Fuller Creek NF Fuller Creek SF Fuller Creek Haupt Creek	South Fork Marshall Creek Sproule Creek McKenzie Creek

In 1995, coho salmon were observed in Robinson and Dry creeks (both are tributaries to the North Fork (Gualala Redwoods, Inc. 1995). Brown and Moyle (1991) do not include Robinson or Dry creeks as historically containing coho salmon. During 1998 snorkel surveys, coho young-of-the-year were observed in Robinson Creek, a tributary to the North Fork (Gualala Redwoods, Inc. 1998)

For the NCWAP and the CDFG Coho Salmon Status Review, the known historic coho salmon streams and additional streams with current habitat inventory surveys were electrofished to determine presence using the Ten Pool Protocol in 2001 (Preston et al. 2001). The North Fork, Franchini Creek, Wheatfield Fork, Haupt Creek, House Creek, Pepperwood Creek, Danfield Creek, Tombs Creek, Marshall Creek, and the South Fork were electro-fished. Coho were not observed on any of these streams. House, Pepperwood, Danfield, and Tombs Creeks were not considered to be historic coho streams and were surveyed for steelhead presence.

In 2002, coho salmon were found on Dry Creek, Doty Creek and on the Little North Fork (Gualala Redwoods, Inc. unpub. 2002; CDFG unpub. 2002). The Gualala River Steelhead Project rescued and relocated 163 young-of-the-year coho from McGann Creek during May, June and July 2002 (R. Dingman, pers. comm). The current distribution of coho salmon appears restricted to the North Fork Subbasin in tributaries of both the North Fork and Little North Fork (Table 4).

Table 4: Current 2002 Coho Salmon Distribution in the Gualala River Watershed, CA.

Subbasin	North Fork	Rockpile	Buckeye	Wheatfield Fork	Main Stem South Fork
Tributaries	Doty Creek Dry Creek Little North Fork McGann Gulch Ck.	Not surveyed	Not surveyed	Not surveyed	Not surveyed

Figure 2 shows the historic distribution of coho salmon based upon bank observations during CDFG stream surveys in 1964 and 1970. In the mid 1950s to the mid 1960s the most substantial tractor logging occurred. During this period, debris accumulations and logjams created fish passage barriers, probably reducing the distribution of coho salmon in the Gualala River Watershed.

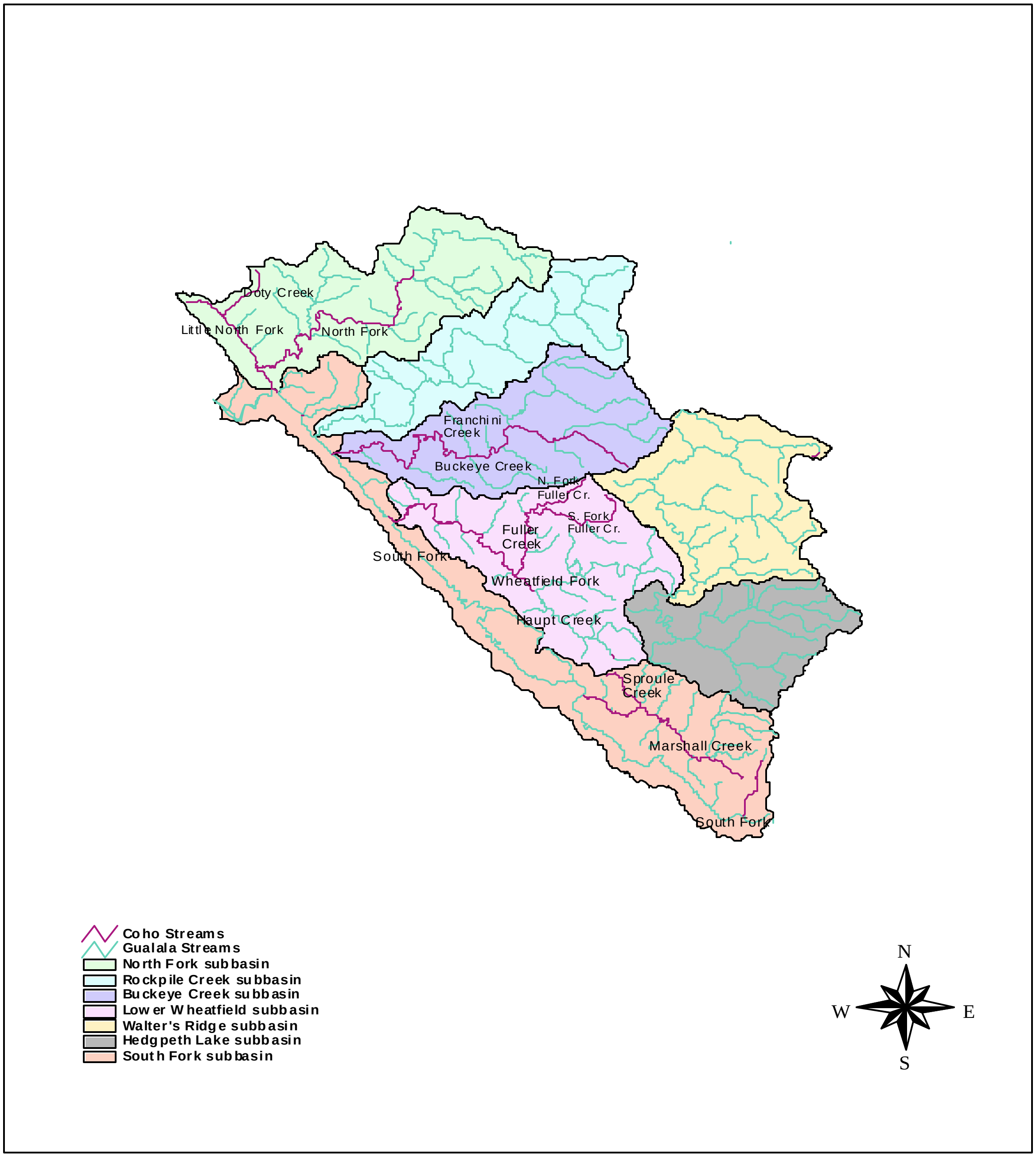

Fig. 2: Historic coho salmon (*Oncorhynchus kisutch)* distribution based on CDFG stream reports from pre-planting in 1964 and post-planting 1970 in the Gualala River Watershed, CA.

Data does not exist to confirm the steelhead trout distribution prior to the mid 1950s-60s logging era (Table 5). Slash and log jams located in both tributaries and headwater areas are well documented in the 1964 and 1970 stream surveys. This logging debris caused barriers to fish passage, thus probably reduced steelhead trout distribution from its potential pre-logging range.

Table 5: Historic Steelhead Trout distribution (*Oncorhynchus mykiss*) based Upon CDFG Stream Surveys from 1960s and 70s in the Gualala River Watershed, CA.

Subbasin	North Fork	Rockpile	Buckeye	Wheatfield Fork	South Fork
Streams	North Fork Dry Creek Robinson Creek Little North Fork Doty Creek	No surveys conducted	Buckeye Creek Franchini Creek	Wheatfield Fork Fuller Creek North Fork Fuller Creek South Fork Fuller Creek House Creek Britain Creek Danfield Creek Jim Creek Sugarloaf Creek Patchett Creek	South Fork Marshall Creek Sproule Creek McKenzie Creek Palmer Canyon Creek Haupt Creek

Steelhead trout distribution in the Gualala River Watershed does not appear to have changed over the past 37 years. This conclusion is based on comparison between stream surveys from 1964 and 1970 and the habitat inventory and electrofishing surveys of 2001 (Fig. 3). Sugarloaf and Patchett Creeks were not surveyed in 2001. Young-of-the-year, one year old and older steelhead trout were observed in all of the tributaries surveyed. Young-of-the-year steelhead trout were the most numerous age class observed. The 10 Pool Protocol was designed to detect coho salmon was used during the 2001 electrofishing surveys. Population and age class estimates cannot be determined from the resulting data (Preston et al, 2001).

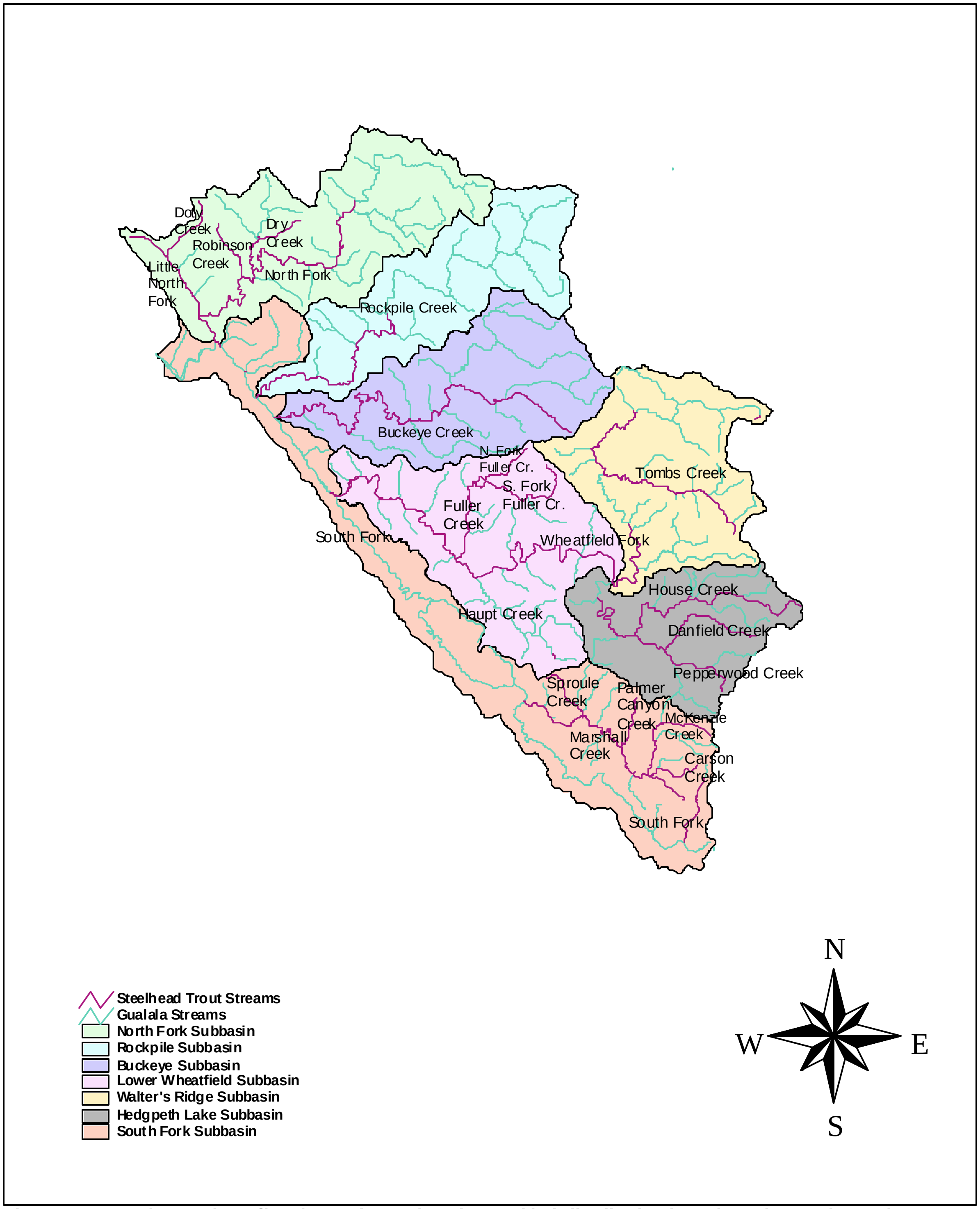

Fig. 3: Current observed steelhead trout (*Oncorhynchus mykiss*) distribution based on observations taken during habitat inventories and electrofishing surveys in 1995, 1999, and 2001 in the Gualala River Watershed, CA.

FISH RESTRICTIONS, ACTS, PROTECTIONS

Due to declining north coast populations, NMFS listed coho salmon under the federal Endangered Species Act (ESA) in 1996. Steelhead trout are currently listed as threatened under the federal ESA. The "threatened" status restricts river sport fishing for steelhead trout on Gualala River. The winter steelhead trout fishery of the Gualala River is currently managed as a catch and release fishery from November 1 to March 31. Only barbless hooks may be used. One hatchery trout or one hatchery steelhead trout may be taken. The summer fishery currently spans from the fourth Saturday of May to October 31. Only artificial lures may be used and no fish may be taken. The legal fishing limits are on the Main Stem (South Fork) of the Gualala River from the mouth, at the Pacific Ocean, to the confluence of the Wheatfield and South forks. Contact CDFG for current regulations or visit the CDFG website at www.dfg.ca.gov.

SPECIAL STATUS SPECIES

The Gualala River is part of the Central California Coast coho salmon Evolutionary Significant Unit (ESU). Coho salmon are listed as endangered under both the State and federal Endangered Species Act in the Central California Coast ESU. Most abundance trend indicators for streams in the CCC coho ESU indicate a decline since the late 1980s. However, some streams of the Mendocino County coast showed an upward trend in 2000 and 2001. Time-series analysis for these streams showed a declining trend and predicts that this trend will continue, despite the recent increases. However, these populations are more vulnerable to extinction due to their small size, and the spatial isolation of this region due to extirpation of coho salmon populations to the north and south. Coho salmon populations in streams in the northern portion of this ESU seem to be relatively stable or are not declining as rapidly as those to the south are. However, the southern portion, where widespread extirpation and near-extinctions have occurred, is a major and significant portion of the range of coho salmon in this ESU. Small population size along with large-scale fragmentation and collapse of range observed in data for this area indicate that metapopulation structure may be severely compromised and remaining populations may face greatly increased threats of extinction because of this. For this reason, the CDFG concludes that CCC coho salmon are in serious danger of extinction throughout all or a significant portion of their range (Coho Salmon Status Review, 2002).

OTHER FISH AND AQUATIC ORGANISMS

Historically, the presence of non-game fish species was recorded with varying degrees of accuracy during stream surveys and electrofishing surveys. Data collection on these species made little attempt to count their numbers or document their presence. Rough-Skinned Newt, Pacific Giant Salamander, and Yellow-Legged Frogs were observed during electrofishing and habitat inventory surveys.

Table 6: Non-salmonid species documented in the Gualala River Watershed, CA.

North Fork Subbasin	Rockpile Creek Subbasin	Buckeye Creek Subbasin	Wheatfield Fork Subbasin	South Fork Subbasin
Gualala Roach	No Data	Yellow Legged Frog	Gualala Roach	Gualala Roach
Three-Spine Stickleback		Pacific Giant Salamander	Three-Spine Stickleback	Three-Spine Stickleback
Prickly Sculpin			Prickly Sculpin	Prickly Sculpin
Sculpin			Coast Range Sculpin	Sculpin spp.
Pacific Lamprey			Pacific Lamprey	Pacific Lamprey
Pacific Giant Salamander			Yellow-Legged Frog	Yellow-Legged Frog
			Rough Skinned Newt	
			Turtles	
			Garder Snakes	

RESULTS OF FISH HABITAT RELATIONSHIP DATA

HISTORIC FISH HABITAT RELATIONSHIP

In 1964, 1970, 1977 and 1981, CDFG conducted stream surveys on various tributaries in the five subbasins of the Gualala River. The stream surveys conducted in 1964 and 1970 coincided with the end of an extensive period of logging in the Gualala River Watershed. The results of the historic stream surveys are not quantitative and can't be used in comparative analyses with current habitat inventories. The data from these stream surveys provide a snapshot of the conditions at the time of the survey (Table 7). Terms such as excellent, good, fair and poor were based upon the opinion of the biologist or scientific aid conducting the survey.

Fish presence observations in the estuary from the 1980s are summarized in "An Account of the Fishes Caught in the Lower Gualala River, California, 1984 through 1986" (Brown 1986): "Sampling occurred at seven stations, two upstream of the Highway 1 bridge. "We caught seven species of fishes in the Gualala Estuary and lower river. Steelhead trout were caught at all stations. Roach, coastrange and prickly sculpin were caught at lower river and upper estuary stations. Starry flounder and Pacific staghorn sculpin were caught only in the lower estuary near the ocean. Threespine stickleback were caught in the lower river and upper to mid-estuary." Steelhead trout are larger in the fall than in the spring at mid-estuary stations, but larger in the spring at lower estuary stations."

In response to the 1964 management recommendations listed in the stream surveys, logging debris, log jams, and other woody materials were cleaned (cleared) from streams by CDFG and the California Conservation Corps throughout the Watershed in the 1970s and 1980s.

Table 7: Summary of historic (1964-1981) stream surveys conducted in the Gualala Basin, CA.

Tributary	Date Surveyed	Habitat Comments	Barrier Comments	Management Recommendations
NORTH FORK SUBBASIN North Fork	9/17 and 18/1964	Excellent steelhead trout, coho salmon spawning and nursery stream. Spawning areas poor in the upper ½ of the stream and excellent in the lower ½ of the stream; Pool: Riffle ratio 50:50; Good shelter provided by logs, boulders, algae, and roots	None	Should be managed as a steelhead trout, coho salmon stream; The future planting of coho salmon is recommended to increase the population; The removal of log jams is not recommended
Little North Fork	9/10/1964	Fair spawning area with loose gravel available, approximately 60% of the stream available for spawning, spawning area suitable for steelhead trout and coho salmon; Pool: Riffle ratio 80:20; Good shelter available as undercut banks, overhanging vegetation, logs, and rocks	30 partial barriers	Continue to manage as a steelhead trout, coho salmon spawning and nursery stream; Habitat improvement, consisting of removal of slash and debris and log jams to improve fish passage and stream condition is suggested; Possible planting of coho salmon to establish a better run is recommended
ROCKPILE SUBBASIN **No tributaries surveyed**	None	No data	No data	No data
BUCKEYE SUBBASIN Buckeye Creek	8/27/64 8/19/70	Good spawning and rearing area; 50% pools; Steelhead present. Silt and sand dominated substrate indicating poor spawning; 25% pools;	Some partial barriers	Replant riparian vegetation; remove log jams
North Fork Buckeye Creek	8/5/64 8/5/82	Pools 25%; Sluggish water with algal bloom. Pools 40%;	Slash; Log jams	Plant riparian; Improve poor logging practice Plant riparian to reduce water temperature.
WHEATFIED SUBBASIN Wheatfield Fork	9/28/1964	Good spawning beds; Pool: Riffle ratio 75:25; Shelter provided by boulders, logs, overhanging water grasses, and undercut banks	Waterfall ¼ mile below the upper limit of anadromy; No complete fish passage barriers	Clearing of the log jam and clearing of the falls
Fuller Creek	8/18-19/ 1964	Spawning area fair, with less than 50% of the streambed containing suitable spawning area and gravel; Pool: Riffle ratio 70:30; Logs, rocks, and undercut banks provided good shelter	9 partial barriers consisting of log jams	Removal of log jams to improve passage; Possible planting of coho salmon to re-establish a self-supporting run

Tributary	Date Surveyed	Habitat Comments	Barrier Comments	Management Recommendations
Haupt Creek	8/25/1964	With a general clean-up and proper management, could become a first class steelhead trout, coho-salmon producing stream A large amount of good spawning area available, consisting of loose gravel deposits, some places 60 feet wide; Pool: Riffle ratio 80:20; Good shelter provided by algae, boulders, undercut banks, and logs	17 partial barriers, consisting of log jams; 1 fish passage barrier 20 log jams; no fish passage barriers	Removal of barriers; Removal of slash from streambed to improve nursery area; Careful management of a coho salmon program to re-establish a run in a stream which has a tremendous amount of suitable coho salmon spawning area
	6/24/70	Spawning area from mouth to upper fish limit; pool/riffle ratio, 60: 25 of shelter in the first 100 feet of stream.		Remove logjams from mouth to upper fish limit 6 miles upstream.
House Creek	9/17/65- 9/18/65	Pools: 60-80% in summer; Shelter is inadequate; Conditions favor rough fish over salmonids;	Concrete dam Numerous small log jams in headwaters and tributaries	Manage as steelhead spawning and nursery.
Patchett Creek	8/20/1964	40% of the streambed below the upper anadromy limit good; Shelter provided by logs, undercut banks, overhanging grass – scarce in some areas	15 log jams between mouth and upper limit of anadromy; 3 waterfalls	Removal of 15 log jams from mouth to bedrock falls 150 feet below the first fork
SOUTH FORK MAIN STEM SUBBASIN	9/23 and 9/24 1964	Plentiful spawning areas throughout the stream. Pool:Riffle 95:5 Generally poor shelter consisting of overhanging banks, boulders, logs, aquatic plants and overhanging aquatic plants.	Old Log Jams None Complete	Continue to manage for production of juvenile steelhead trout and coho salmon
South Fork	5/17 and 18/1977	Summer flows are limited ; Pool: Riffle ratio 7:3; The majority of pools had little to no shelter; Shelter consisted of boulders, aquatic plants, logs, undercut banks, and overhead canopy	No barriers observed; Each summer a dam is constructed approximately ½ mile below the Wheatfield Fork	
Marshall Creek	9/28/1964	Deposits of good spawning gravel exist throughout the stream from the mouth to the upper fisheries value; Pool: Riffle ratio 50:50; Good shelter provided by logs, boulders, undercut banks, roots, and trees	No complete barriers	Should be managed as a steelhead trout and coho salmon spawning and nursery stream
Marshall Creek Tributary #3	9/28/1964	Very limited fisheries value; Watershed severely burned 10 years ago Lower half mile has spawning gravel available, but summer flow is very low	Total barrier to fish a half mile above the mouth	None
Marshall Creek Tributary #5	9/29/1964	Summer flows are limited. Some suitable spawning gravel directly above large log jams	Over 40 log jams in a 1 mile stretch of stream; A number form complete fish passage barriers	Remove log jams
McKenzie Creek	9/23 and 24/1964	Spawning areas fair to good in the lower 1/3 of stream, excellent in the middle section of stream, and fair in the upper 1/3 of stream; Pool: Riffle ratio 60:40; Good shelter provided by rocks and undercut banks	7 partial barriers; Large 7 feet high 40 feet dam present 1/6 mile upstream from mouth; Large bedrock falls 1-1/4 miles upstream	Continue to manage as a coho salmon, steelhead trout spawning and nursery area; After removal of falls, possible planting of coho salmon to re-establish a self-supporting run
McKenzie Creek Tributary #6	10/1/1964	Streambed unsuitable for spawning except for the lower ½ mile of stream which is dry in the summer	Impassable 10 feet falls ½ mile upstream from the mouth	None
Palmer Canyon Creek	7/31/1981	Could become a good spawning area and nursery habitat for rainbow trout/steelhead trout if improved Occasional small isolated spawning areas separated by areas of boulders or heavily silted areas; Adequate vegetative cover, undercut banks and logs are present in the lower and mid sections of stream	9 partial fish passage barriers; 2 complete fish passage barriers	Needs removal of log jams, healing of eroded areas and stream bank cover in upper sections

TARGET VALUES FROM HABITAT INVENTORY SURVEYS

Target Values from the Habitat Inventory Surveys (Flosi et al 1998)

Beginning in 1991, habitat inventory surveys were used as a standard method to determine the quality of the stream environment in relation to conditions necessary for salmonid health and production. In the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 1998) target values were given for each of the individual habitat elements measured (Table 8). When habitat conditions fall below the target values, restoration projects may be required to meet critical habitat needs for salmonids

Table 8: Habitat Inventory Target Values Taken from the California Salmonid Stream Habitat Restoration Manual (Flosi et al 1998)

Habitat Element	Canopy Density	Embeddedness	Primary Pool Depth/Frequency	Shelter/Cover
Range of Values	0-100%	0-100%	0-40%	Ratings range from 0-300
Target Values	>80%	>50% or greater of the pool tailed surveyed provides good spawning conditions	Depth - 1st and 2nd order streams >2 feet 3rd and 4th order streams >3 feet Frequency->40% of stream	>80

Canopy Density- 80 Percent or Greater of the Stream is Covered by Canopy

Near-stream forest density and composition contribute to microclimate conditions. These conditions help regulate air temperature and humidity, which are important factors in determining stream water temperature. Along with the insulating capacity of the stream and riparian areas during winter and summer, canopy levels provide an indication of the potential present and future recruitment of large woody debris to the stream channel. Revegetation projects should be considered when canopy density is less than the target value of 80 percent.

Good Spawning Substrate- 50 Percent or Greater of the Pool Tails Sampled are 50 Percent or Less Embedded

Cobble embeddedness is the percentage of an average sized cobble piece, embedded in fine substrate at the pool tail. The best coho salmon and steelhead trout spawning substrate are 0-50 percent embedded. Category 1 is defined by the substrate being 0-25 percent embedded. Category 2 is defined by the substrate being 26-50 percent embedded. Cobble embedded deeper that 51 percent is not within the range for successful spawning. The target value is 50 percent or greater of the pool tails sampled are 50 percent or less embedded, thus provides good spawning substrate conditions. Streams with less than 50 percent of their length greater than 51 percent embedded do not meet the target value or provide adequate spawning substrate conditions.

Pool Depth/Frequency- 40 Percent or More of the Stream Provides Pool Habitat

During their life history, salmonids require access to pools, flatwater, and riffles. Pool enhancement projects are considered when pools comprise less than 40 percent of the length of total stream habitat. The target values for pool depth are related to the stream order. First and second order streams are required to have 40 percent or more of the pools 2 feet or deeper to meet the target values. Third and fourth order streams are required to have 40 percent or more of the pools 3 feet or deeper to meet the target values. A frequency of less than 40 percent or inadequate depth related to stream order indicates that the stream provides insufficient pool habitat.

Shelter/Cover- Scores of 80 or Better Means that the Stream Provides Sufficient Shelter/Cover

Pool shelter/cover provides protection from predation and rest areas from high velocity flows for salmonids. Shelter/cover elements include undercut bank, small woody debris, large woody debris, root mass, terrestrial vegetation, aquatic vegetation, bubble curtain (whitewater), boulders and bedrock ledges. All elements present are measured and scored. Shelter/cover values of 80 or less indicates that shelter/cover enhancement should be considered.

CURRENT FISH HABITAT RELATIONSHIP

Habitat inventory surveys were conducted on a total of 28 streams since 1995 (Figure 4 and Table 9). In 2001, CDFG conducted over 100 miles of habitat inventory surveys on 18 streams. These surveys were completed under the direction of NCWAP. Prior to NCWAP, approximately 15 miles of current habitat inventory data existed. This includes four streams by Sotyome Resource Conservation District in 1995 and four streams inventoried by CDFG in 1999.

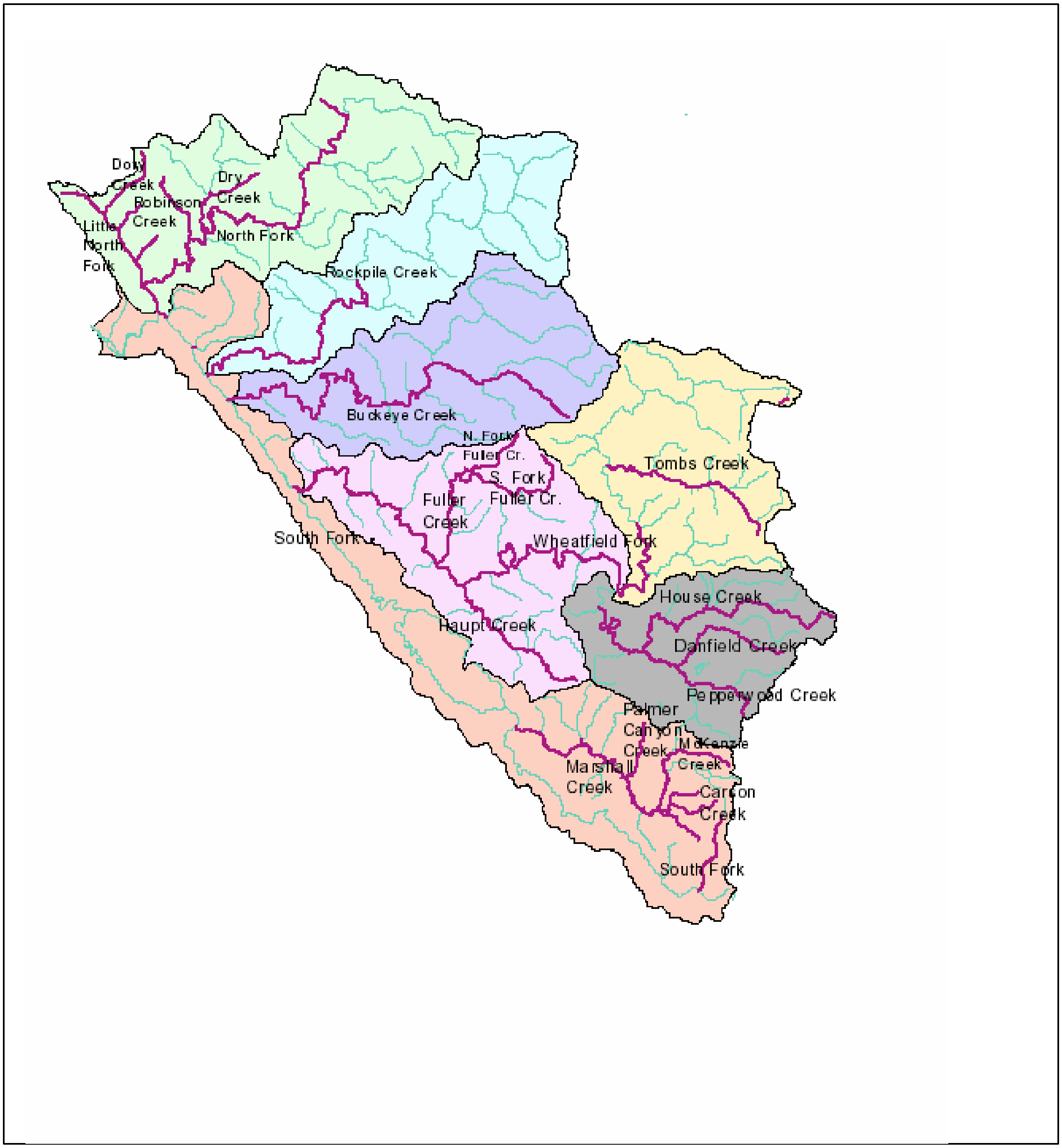

Fig. 4: Current Habitat Inventory Surveys from 1995, 1999, and 2001 on the Gualala River Watershed, Gualala, CA.

Table 9: Summary of habitat inventory surveys conducted in all Gualala River Basin, 1995-2001

Super Planning Watershed	Habitat Typing	Stream Lnth (mi.)	Survey Lnth (mi.)	Channel Type	Stream Order	Percentage of Streams Completed
NORTH FORK						81%
Doty Creek	2001	2.7	1.2	F4, B1	1	
Dry Creek	2001	3.2	2.1	F4	1	
North Fork	2001	13.3	11.3	F4	3	
Little North Fork	2001	4.1	3.9	F4	2	
Log Cabin Creek	2001	1.1	0.3	F4	1	
McGann Gulch	2001	2.1	0.4	F4	1	
Robinson Creek	2001	1.8	1.5	F4	1	
Stewart Creek	2001	2.3	1.5	F4	1	
ROCKPILE				F4		39%
Rockpile		21.8	9	F4	2	
BUCKEYE				F4		37%
Buckeye	2001	18.9	19	F4	3	
WHEATFIELD				F4		62%
Fuller Creek	1995	3.4		F4	3	
Haupt Ck	2001	5.8	0.5	F4	2	
NF Fuller Creek	1995	2		F1, B4, A4, E3,	2	
SF Fuller Creek	1995	5.1		F4, B3, B4, B1, E4	2	
Sullivan Ck	1995	1	1	E4, E5, B4	1	
Wheatfield Fork	2001	35.9	22.1	F4	3	
WALTER'S RIDGE						32%
Tombs Creek	2001	6	7.1	B4	2	
HEDGEPETH LAKE				F4		42%
House Creek	2001	13.6	10.4	F4	1	
Pepperwood Creek	2001	4.6	3.4	F4	3	
Danfield Creek	2001	2.3	2.3	F4	1	
SOUTHFORK/MS				F4		31%
Camper Ck	1999			F4		
Carson Ck	1999	2.3		F4	2	
Upper SF Gualala	2001			F4		
Marshall Creek	2001	7.5	1.6	F4	3	
McKenzie Creek	1999	4.1		F4	2	
Palmer Cyn Ck	1999	0.8		F4	1	
Sproule Creek	2001	1.4	0.1	F4	2	
Wld HogCyn Ck	1999			F4		

Canopy cover, embeddedness, primary pool depth/frequency and shelter cover are summarized in Table 10. Condensed Tributary Reports are located in Attachment F.

In the North Fork Subbasin, the canopy cover target value was reached on Log Cabin Creek. All of the other streams surveyed in the North Fork Subbasin were close to the target value except Dry and Robinson creeks. Embeddedness target values were attained or exceeded on all tributaries except Doty and McGann creeks. The target values for Pool Frequency/Depth and Pool Shelter/Cover were not met on any of the streams surveyed.

In the Rockpile Subbasin, 8.5 miles were surveyed on Rockpile Creek, they only stream surveyed. The canopy cover target value was not met. Embeddedness target value was reached. The target values for Pool Frequency/Depth and Pool Shelter/Cover were not met.

In the Buckeye Subbasin, the canopy cover target value was not met on Buckeye Creek, the only stream surveyed. Embeddedness target value was reached on Buckeye Creek. The target values for Pool Frequency/Depth and Pool Shelter/Cover were not met.

In the Wheatfield Subbasin, the canopy cover target value was met on Sullivan Creek. None of the other nine streams surveyed met the target value. House, Pepperwood, Sullivan, and Tombs creeks, and the Wheatfield Fork met the target values for embeddedness. The target values for Pool Frequency/Depth or Pool Shelter/Cover were not met in any of the streams surveyed.

In the Mainstem/South Fork Subbasin, the canopy cover target value was met on Palmer Canyon , Carson, and Camper Creeks, and on surveyed reaches of the upper South Fork. The target values for Pool Frequency/Depth or Pool Shelter/Cover were not met in any of the streams surveyed.

Table 10: Summary of Current (1995, 1997, and 2001) Conditions Based Upon Habitat Inventory Surveys from the Gualala River Watershed, CA.

Habitat Element Stream Name	Surveyed Length (feet).	Canopy Cover	Embeddedness	Primary Pool Depth/ Frequency	Shelter Cover Ratings
Target Values (Flosi et al 1998)		***>80%r***	***>50%***	***>40%***	***>80***
North Fork Subbasin					
Doty Creek	6,237	74%	25%	4%	36
Dry Creek	11,161	58%	70%	6%	32
Dry Creek Tributary #1	2,695	59%	51%	22%	30
Little North Fork	20,806	76%	83%	16%	54
Log Cabin Creek	1,698	83%	90%	1%	43
McGann Creek	1,980	76%	0%	3%	5
North Fork *(partial survey)*	59,362	78%	82%	29%	28
Robinson Creek	7,819	66%	65%	3%	70
Rockpile Subbasin	44,500				
Rockpile Creek	44,500	55%	52%	22%	41
Buckeye Subbasin	51,085				
Buckeye Creek	51,085	61%	68%	11%	44
Wheatfield Fork Subbasin	289,627				
Danfield Creek	2,103	49%	28%	5%	26
Fuller Creek (1995)	17,952	66%	3%	5%	25
North Fork Fuller Creek (1995)	14,275	68%	20%	13%	58
South Fork Fuller Creek (1995)	23,198	59%	28%	13%	37

Habitat Element Stream Name	Surveyed Length (feet).	Canopy Cover	Embeddedness	Primary Pool Depth/ Frequency	Shelter Cover Ratings
Target Values (Flosi et al 1998)		***>80%r***	***>50%***	***>40%***	***>80***
House Creek	54,916	21%	70%	8%	15
Pepperwood Creek	17,931	19%	70%	16%	12
Sullivan Creek (1995)	5,015	89%	63%	7%	36
Tombs Creek	37,359	65%	55%	9%	51
Wheatfield Fork	116,878	45%	50%	25%	17
Mainstem/South Fork Subbasin	57,218				
Camper Creek (1999)	3,546	86%	70%	3%	25
Carson Creek (1999)	6,834	83%	50%	14%	19
Marshall Creek *(partial survey)*	21,698	55%	90%	13%	13
McKenzie Creek (1999)	3,801	69%	60%	18%	23
Palmer Canyon Creek	95	82%	65%	3%	12
Upper South Fork *(partial survey)*	8,451	96%	73%	5%	22
Wild Hog Creek	2,493	73%	52%	2%	8

CHANGES IN HABITAT CONDITIONS FROM 1964 TO 2001

Streams surveyed in 1964 and habitat inventory surveyed in 1995, 1999, and 2001 were compared to indicate changes between historic and current conditions (Table 11). Data from the 1964 stream surveys provide a snapshot of the conditions at the time of the survey. Terms such as excellent, good, fair, and poor are based on the judgment of the biologist or scientific aid conducting the survey. The results of the historic stream surveys are qualitative and cannot be used in comparative analyses with the quantitative data provided by the habitat inventory surveys, with any degree of accuracy. However, the comparison of the two data sets may be used to show general trends. Data was not available to indicate habitat conditions prior to 1964, thus it is unknown if the conditions observed showed a decline or improvement in habitat conditions.

According to the aerial photographs analyzed by CDF (located in the Gualala Synthesis Report, section 3.6.4), the canopy density of the 1960s was greatly reduced from the conditions observed in the 1940s. The canopy appeared to be low or absent in many parts of the basin.

In the North Fork Subbasin, the Little North Fork and the North Fork were both surveyed in 1964 and 2001. The canopy cover has increased significantly on both streams indicating a recovered condition over those observed in the 1960s aerial photographs. The 2001 spawning substrate conditions may have improved on the Little North Fork or remained the same; to the conditions were similar to those observed in 1964. The 2001 spawning substrate has improved on the upper reach and remained the same on the lower reach of the North Fork over conditions observed in 1964. The 2001 pool frequency/depth and shelter cover appear to have decreased since 1964

Data was unavailable for comparison in the Rockpile Subbasin.

In the Buckeye Subbasin, only Buckeye Creek was surveyed in 1964 and 2001. The canopy cover has increased somewhat indicating some improvement toward a recovered condition over those observed in the 1960s aerial photographs, but still did not meet target values. The 2001 spawning substrate conditions continued to provide the same acceptable conditions observed in 1964. It is unknown whether the substrate has remained acceptable or has returned to the conditions observed in 1964. The 2001 pool frequency/depth and shelter cover appeared to have decreased since 1964.

In the Wheatfield Subbasin, House and the Wheatfield Fork were surveyed in 1964 and 2001. Fuller Creek was surveyed in 1964 and 1995. The canopy cover on House Creek and the Wheatfield Fork appeared to have decreased or remained the same and still did not meet target values, indicating little or no improvement over those observed in the 1960s aerial photographs. Fuller Creek's canopy cover appeared to have increased somewhat indicating some improvement, but still did not meet target values. The spawning substrate on House Creek appeared to have improved somewhat, while the Wheatfield Fork has remained or returned to the same acceptable conditions observed in 1964. Spawning substrate conditions appear to have decreased on Fuller Creek indicating a decline of upstream or upslope habitat conditions. The 2001 pool frequency/depth and shelter cover appeared to have decreased since 1964 on Fuller Creek and the Wheatfield Fork. On House Creek, the pool frequency/depth appeared to have decreased while the shelter/cover values has remained deficient.

In the South Fork/Mainstem Subbasin, Marshall Creek and the Wheatfield Fork were surveyed in 1964 and partial surveys were conducted in 2001. The canopy cover had increased in the headwaters area of the South Fork, indicating a recovered condition over those observed in the 1960s aerial photographs. On Marshall and McKenzie Creeks, the canopy cover appeared to have increased somewhat indicating some improvement, but still did not meet target values. The 2001 pool frequency/depth and shelter cover appear to have decreased since 1964 on Marshall and McKenzie Creeks. The headwaters area of the South Fork appeared to have had a decrease in pool frequency/depth since 1964, while the shelter/cover conditions has remained deficient.

Table 11: Comparison between historic habitat conditions observed in 1964 with current habitat inventory surveys based upon quantitative measurements in 1995, 1999 and 2001 from the Gualala River Basin, CA.

Subbasin Stream	**1960s Canopy Cover Photos**	**2001 Canopy Cover**	**1964 Spawning Conditions**	**2001 Spawning Conditions**	**1964 Pool Depth/ Freq**	**2001 Pool Depth/ Freq**	**1964 Shelter Cover**	**2001 Shelter Cover**	**Change in conditions from 1964 to Current**
North Fork Subbasin		>80%		>50%		>40%		>80	
Little North Fork	Low or Absent	76%	Good	83%	50%	16%	Good	54	Recovered canopy: Improved or same good spawning conditions: Decreased pool habitat and shelter/cover.
North Fork	Low or Absent	78%	Excellent	82%	80%	29%	Good	28	Recovered canopy: No change or return to good spawning conditions: Decreased pool habitat and shelter/cover.
Buckeye Subbasin									
Buckeye Creek	Low or Absent Replant	61%	Good	68%	50%	11%	N/A	44	Some canopy recovery: Improved spawning conditions: Decreased pool habitat and shelter/cover.
Wheatfield Fork									
Fuller Creek (1995)	Low or Absent	66%	Fair	3%	70%	5%	Good	25	Some canopy recovery: Decreased spawning conditions, pool habitat and shelter/cover.
House Creek	Low or Absent	21%	Good	70%	70%	8%	Inadequate	15	Little or no recovery of canopy: Improved spawning conditions: Decreased pool habitat: No change in shelter/cover.
Wheatfield Fork	Low or Absent	45%	Good	50%	75%	25%	Good	17	Some canopy recovery: No change or return of good spawning conditions: Decreased pool habitat and shelter/cover.

Subbasin Stream	1960s Canopy Cover Photos	2001 Canopy Cover	1964 Spawning Conditions	2001 Spawning Conditions	1964 Pool Depth/ Freq	2001 Pool Depth/ Freq	1964 Shelter Cover	2001 Shelter Cover	Change in conditions from 1964 to Current
Main stem /South Fork									
Marshall Creek	Low or Absent	55%	Good	90%	50%	13%	Good	13	Some canopy recovery: Improved spawning conditions. Decreased pool habitat and shelter/cover.
McKenzie Creek (1999)	Low or Absent	69%	Good	60%	60%	18%	Good	23	Some canopy recovery: Improved spawning conditions: Decreased pool habitat and shelter/cover.
Upper South Fork	Low or Absent	96%	Good	73%	95%	5%	Poor	22	Recovered canopy: Improved spawning conditions. Decreased pool habitat and shelter/cover.

LIMITING FACTOR ANALYSIS

The overall limiting factors for the Gualala Basin are based upon limited data. Only 81% of the North Fork Subbasin, 39% of the Rockpile Subbasin, 37% of the Buckeye Subbasin, 62% of the Wheatfield Subbasin, and 31% of the South Fork/Mainstem Subbasin were surveyed in 2001. Basin-wide, pool shelter related to escape cover first, pool depth second, canopy cover third and embeddedness fourth based on the surveys conducted in 2001. Pool depth related to summer conditions and pool shelter related to escape/cover were the greatest limiting factors on all five subbasins. Canopy cover related to water temperature was the third limiting factor in Rockpile, Buckeye and the North Fork Subbasins. Embeddedness related to spawning substrate conditions was the third limiting factor in the Wheatfield Fork and Mainstem/South Fork Subbasins and the fourth in the North Fork, Rockpile and Buckeye Subbasins (Table 12). Embeddedness related to spawning substrate conditions was the third limiting factor in the Wheatfield Fork and Mainstem/South Fork Subbasins and the fourth in the North Fork, Rockpile and Buckeye Subbasins (Table 13). .Limiting factor in the Mainstem, North Fork and South Fork of Fuller Creeks was embeddedness. Pool Depth was the highest limiting factor on Sullivan Creek (Table 14).

Table 12: Limiting Factors Affecting Salmonid Health and Production Based Upon Habitat Inventory Surveys Conducted in 1999 and 2001 and EMDS Scores in the Gualala River Watershed, CA.

Rank 1 is the most limiting factor

Gualala River Watershed	Canopy Cover Related to Water Temperature	Embeddedness Related to Spawning Suitability	Pool Depth Related to Summer Conditions	Pool Shelter Related to Escape and Cover
Gualala Basin	3	4	2	1
North Fork Subbasin	3	4	2	1
Rockpile Subbasin	3	4	1	2
Buckeye Subbasin	3	4	1	2
Wheatfield Fork Subbasin	4	3	2	1
Main stem/ South Fork (1999 and 2001)	4	3	2	1

Table 13: Limiting factors affecting salmonid health and production based upon habitat inventory surveys conducted in 1999 and 2001 and EMDS scores in the Gualala Basin, CA.

Rank 1 is the greatest limiting factor.

Subbasin Stream Name	**Canopy Cover Related to Water Temperature**	**Embeddedness Related to Spawning Suitability**	**Pool Depth Related to Summer Conditions**	**Pool Shelter Related to Escape and Cover**
North Fork Subbasin Score	3	4	2	1
Doty Creek		3	1	2
Dry Creek	3	4	1	2
Dry Creek Trib. # 1	3		1	2
Little North Fork			1	2
LNF Trib. # 1			1	2
Log Cabin Creek			1	2
McGann Creek		3	2	1
North Fork				1
Robinson Creek	2		1	
Rockpile Subbasin Score	3	4	1	2
Rockpile Creek	3	4	1	2
Buckeye Subbasin Score	3	4	1	2
Buckeye Creek	3	4	1	2
Wheatfield Fork Subbasin Score	4	3	2	1
Danfield Creek	1	4	3	2
House Creek	1	4	3	2
Pepperwood Creek	1	4	3	2
Tombs Creek	2	4	1	3
Wheatfield Fork	2	3		1
Main stem/ South Fork Score			2	1
Camper Creek (1999)			1	2
Carson Creek (1999)		3	2	1
Marshall Creek (partial survey)	2	4	3	1
McKenzie Creek (1999)	3	4	2	1

Subbasin Stream Name	**Canopy Cover Related to Water Temperature**	**Embeddedness Related to Spawning Suitability**	**Pool Depth Related to Summer Conditions**	**Pool Shelter Related to Escape and Cover**
Palmer Canyon Creek		3	2	1
Upper South Fork (partial survey)		3	2	1
Wild Hog Creek (1999)	3	4	2	1

Table 14: Limiting factors affecting salmonid health and production in the Fuller Creek watershed located in the Wheatfield Subbasin of the Gualala River, CA, based upon habitat inventory surveys conducted in 1995. Rank of 1 is most limiting factor.

Watershed Stream Name	**Canopy Related to Water Temperature**	**Embeddedness Related to Spawning Suitability**	**Pool Depth Related to Summer Conditions**	**Pool Shelter Related to Escape and Cover**
Fuller Creek	4	1	2	3
North Fork Fuller Creek	4	1	2	3
South Fork Fuller Creek	4	1	2	3
Sullivan Creek		3	1	2

ECOLOGICAL MANAGEMENT DECISION SUPPORT REACH MODEL SCORES

Although the EMDS model outputs were based upon the habitat inventory data, the method of analysis differed. The EMDS model used a weighted average approach and divided the stream length into reaches based upon channel type. The analysis was expressed in degrees of habitat suitability for salmonid health and production.

Table 15: Ecological Management Decision Support (EMDS) Reach Model Scores on salmonid heath and productivity suitability for the Gualala Basin, CA, based upon habitat inventory surveys conducted in 1999 and 2001.

+++ =Fully Suitable; ++ = Moderately Suitable; + = Somewhat Suitable; U= Undetermined- = Somewhat Unsuitable; - - = Moderately Unsuitable; --- =Fully Unsuitable

Subbasin Stream Name	**Canopy Cover Score**	**Embeddedness Score**	**Pool Depth Score**	**Pool Shelter Score**	**Pool Quality Score**	**2001 MWAT Water T% Score**
North Fork Subbasin Score	+	+	+	--	-	
Doty Creek	+++	-	---	--	--	
Dry Creek	-	++	---	---	---	+++
Dry Creek Trib #1	-	+	---	--	--	
Little North Fork	+++	++	---	--	--	+++

Subbasin Stream Name	**Canopy Cover Score**	**Embeddedness Score**	**Pool Depth Score**	**Pool Shelter Score**	**Pool Quality Score**	**2001 MWAT Water T% Score**
LNF Trib #1	+++	+	--	--	--	
Log Cabin Creek	+++	+	---	--	--	
McGann Creek	++	---	---	---	---	
North Fork	++	++	+++	---	U	U
Robinson Creek	-	-	---	+	-	+++
Rockpile Subbasin Score	--	-	---	--	--	
Rockpile Creek	--	-	---	--	--	-
Buckeye Subbasin Score	-	+	--	-	-	
Buckeye Creek	-	-	--	-	-	--
Wheatfield Fork Subbasin Score	--	-	-	--	-	
Danfield Creek	---	--		---	---	
House Creek	---	++	---	U	--	
Pepperwood Creek	---	+	---	---	---	
Tombs Creek	-	-	---	-	--	
Wheatfield Fork	--	-	+	---	-	---
Main Stem /South Fork Score	+	+	-	---	--	
Camper Creek (1999)	++	--	---	--	-	
Carson Creek (1999)	+++	--	-	---	--	
Marshall Creek partial survey	--	+	-	---	--	
McKenzie Creek (1999)	+	-	-	--	-	+
Palmer Canyon Creek	++	+	---	---	---	

Subbasin Stream Name	**Canopy Cover Score**	**Embeddedness Score**	**Pool Depth Score**	**Pool Shelter Score**	**Pool Quality Score**	**2001 MWAT Water T% Score**
Upper South Fork Headwaters	+++	++	---	---	---	+++
Wild Hog Creek (1999)	+	-	---	---	---	

RESTORATION RECOMMENDATIONS

Habitat deficiencies, denoted by an "X", are defined as not meeting the habitat target values criteria (Flosi et al 1998) or were recorded by field crews during the survey. The occurrence of the habitat deficiency were tallied for each subbasin (Table 15).

Ten habitat deficiencies have been defined: Bank = failing stream banks, yielding fine sediment into the stream, Road = fine sediment entering the stream from the road system, Canopy = shade canopy below 80%, Temperatures = summer water temperatures recorded above 64°F, Pool = below target values in quantity and/or quality; Shelter Cover = escape cover for salmonids below target values, Spawning Gravel = deficient in depth and/or quantity, LDA = large debris accumulations retaining large amounts of gravel which need modification, Livestock/Feral Pig = stock or feral pigs impacting the stream or riparian area, exclusion should be considered, and Fish Passage = instream barriers to fish migration.

Eight of the ten streams surveyed in the North Fork Subbasin had high occurrences of habitat deficiencies in pool quantity or quality and shelter cover. Roads appeared to contribute fine sediment in six stream channels. Three streams had occurrences of failing stream banks, less than 80% canopy cover, summer water temperatures over 64°F and large debris accumulations. Spawning gravel were deficient in two streams. One fish barrier was recorded on Doty Creek. This barrier, a damned water diversion, provides water to the Gualala River Steelhead Project's rescue pools.

The main stem of Rockpile Creek was surveyed in the Rockpile Subbasin. The stream showed habitat deficiencies related to stream banks, roads, canopy cover, water temperature, pool quantity or quality, and shelter cover.

The main stem of Buckeye Creek was surveyed in the Buckeye Subbasin. This stream showed habitat deficiencies related to roads, canopy cover, water temperature, pool quantity or quality and shelter cover.

Eight of the nine streams surveyed in the Wheatfield Fork Subbasin had high occurrences of habitat deficiencies in canopy cover. Seven streams showed habitat deficiencies in their pool quantity or quality and shelter cover. Roads appeared to contribute fine sediment in six stream channels. Six streams had occurrences failing stream banks and deficient spawning gravel. Five streams had evidence that stock and feral pigs were impacting the stream bank or riparian area and exclusion devices should be considered. Summer temperatures above 64F were recorded in four streams.

All seven streams surveyed in the South Fork Subbasin had occurrences of habitat deficiencies related to roads contributing fine sediment into stream channels. Six streams showed habitat deficiencies in shelter cover and five with pool quantity or quality. Two streams had occurrences of failing stream banks and recorded summer temperatures above 64°F. Marshall Creek had some failing stream banks, many related to stock and feral pigs, exclusion devices should be considered. Carson Creek had deficient spawning gravel. Palmer Canyon Creek had a large logjam, which is a barrier to fish migration.

Table 16: Summary of habitat inventory survey data from the Gualala River tributaries; 1995, 1999, and 2001.

An X indicates that the category did not meet the target values (Flosi et al. 1998) or that field crews observed the deficiency during the survey period.

Subbasin Stream Name	**Survey Length (Ft.)**	**Unstable Bank**	**Roads**	**Canopy Cover**	**Water Temp.**	**Pool Depth**	**Pool Shelter**	**Spawning Gravel**	**LDA**	**Livestock and/or Feral Pigs**	**Fish Passage**
North Fork Subbasin											
Doty Creek	6,237		X			X	X	X	X		X

Subbasin Stream Name	**Survey Length (Ft.)**	**Unstable Bank**	**Roads**	**Canopy Cover**	**Water Temp.**	**Pool Depth**	**Pool Shelter**	**Spawning Gravel**	**LDA**	**Livestock and/or Feral Pigs**	**Fish Passage**
Dry Creek	11,161			X	X	X	X				
Dry Creek Trib #1	2,695			X		X	X				
Little North Fork	20,806		X			X	X				
LNF Trib #1	5,460					X	X				
Log Cabin Creek	1,698	X	X			X	X		X		
McGann Creek	1,980	X				X	X	X			
North Fork	59,362	X	X		X		X				
Robinson Creek	7,819		X	X	X	X			X		
Rockpile Subbasin											
Rockpile Creek	44,500	X	X	X	X	X	X				
Buckeye Subbasin											
Buckeye Creek	51,085		X	X	X	X	X				
Wheatfield Subbasin											
Danfield Creek	12,103	X		X	X	X		X		X	
Fuller Creek (1995)	17,952	X	X	X			X	X			
NFFuller Creek (1995)	14,275			X	X	X	X	X			
SF Fuller Creek (1995)	23,198			X	X	X	X	X			
House Creek	54,916	X	X	X	X	X				X	
Pepperwood Creek	17,931	X		X		X	X			X	
Sullivan Creek (1995)	5,015					X	X	X			
Tombs Creek	37,359	X		X		X	X	X		X	
Wheatfield Fork	116,878	X	X	X			X			X	
Main stem /South Fork											
Camper Creek (1999)	3,546		X				X				
Carson Creek (1999)	6,834		X			X	X	X			
Marshall Creek	21,698	X	X	X	X	X	X			X	
McKenzie Creek (1999)	13,801		X			X	X				
Palmer Canyon Creek	395		X		X						X

Subbasin Stream Name	**Survey Length (Ft.)**	**Unstable Bank**	**Roads**	**Canopy Cover**	**Water Temp.**	**Pool Depth**	**Pool Shelter**	**Spawning Gravel**	**LDA**	**Livestock and/or Feral Pigs**	**Fish Passage**
Upper South Fork	8,451		X	X		X	X				
Wild Hog Creek (1999)	2,493		X			X	X				

The streams listed (tables 15 & 16) have been inventoried for fish habitat using protocols in the *CA Salmonid Stream Habitat Restoration Manual, Third Edition*. Table 17 includes priority ranking of habitat categories that provide improvement opportunities. These recommendations are based on habitat surveys and observations. The most urgent concern is assigned a '1', the next highest a '2', etc.

Table 16 recommendations are created from the results of standard CDFG habitat inventories. These inventories are a combination of several stream reach surveys: habitat typing, channel typing, and biological assessments. An experienced biologist and/or habitat specialist conducts QA/QC on the field crews and the data. The biologist performs data analysis and determines general areas of habitat deficiency based upon the analysis and synthesis of information. Finally, recommendation categories for potential habitat improvement activities are selected and ranked.

It is important to understand that these selections are made from stream reach conditions that are observed at the times of the surveys and do not include upslope watershed observations. They also reflect a single point and do not anticipate future conditions. These general recommendation categories have proven to be useful as the basis for specific project development, design and implementation. Stream and watershed conditions change over time, therefore periodic survey updates and field verification are necessary when considering projects.

In reaches that demonstrate disturbance levels associated with watersheds in current stress, upslope improvements precede instream improvements. Upslope improvement recommendations include erosion and sediment reduction by treating roads and failing stream banks, riparian vegetation improvements, and near stream vegetation improvements. Instream improvement recommendations are a high priority in streams that reflect watersheds in recovery or good health. Project recommendations can be made in concurrence if conditions warrant.

Fish passage problems are usually a treatment priority. NCWAP's watershed-scale upslope assessments can help determine the suitability of conducting instream improvements. There is an important relationship between the instream and upslope assessments.

Additional considerations enter into the decision process before these general recommendations are further developed into improvement activities. In addition to watershed condition considerations, there are logistic considerations when ranking recommendations for project development. These can include work party access limitations, such as lack of private party trespass permission and physically difficult or impossible locations. Biological considerations are made based upon their benefit to multiple or single fish species. Cost benefit and project feasibility are factors in project selection.

Table 17: Priorities for Restoration for the Gualala River Tributaries based upon the 1995, 1997, and 2001 habitat inventory surveys, EMDS and the biologist's professional judgment.

Rank of "1" indicates highest priority.

Stream Name	Bank Stabilization	Roads Repair or Removal	Riparian Canopy Development	Instream Structure Enhancement	Livestock or Feral Pig Exclusion	Barrier Removal
North Fork Subbasin	3	2		1		4
Doty Creek		2	4	1		3
Dry Creek			2	1		
Dry Creek Trib. #1			2	1		
Little North Fork		2		1		
LNF Trib. #1		2		1		
Log Cabin Creek	3	2		1		
McGann Creek	2			1		
North Fork		2		1		
Robinson Creek		2	3	1		
Rockpile Subbasin	3	4	2	1		
Rockpile Creek	3	4	2	1		
Buckeye Subbasin		2	3	1		
Buckeye Creek		2	3	1		
Wheatfield Fork Subbasin	3	5	1	2	4	
Danfield Creek	2		3	4	1	
Fuller Creek (1995)	2	3	1	4		
NF Fuller Creek (1995)			1	2		
SF Fuller Creek (1995)			1	2		
House Creek	3	2	4	5	1	
Pepperwood Creek	4		2	3	1	
Sullivan Creek (1995)				1		
Tombs Creek	2		3	4	1	

Stream Name	**Bank Stabilization**	**Roads Repair or Removal**	**Riparian Canopy Development**	**Instream Structure Enhancement**	**Livestock or Feral Pig Exclusion**	**Barrier Removal**
Wheatfield Fork	2	3	4	1		
Main stem /South Fork	5	2	3	1	6	4
Camper Creek (1999)		2		1		
Carson Creek (1999)		2		1		
Marshall Creek	3	4	1	2	5	
McKenzie Creek (1999)		2		1		3
Palmer Canyon Creek		3	2			1
Upper South Fork (partial survey)		3	2	1		
Wild Hog Creek (1999)			2	1		

POTENTIAL SALMONID REFUGIA

The concept of refugia is based on the premise that patches of aquatic habitat provide the critical ecologic functions to support wild anadromous salmonids. Refugia may exist in areas where the surrounding landscape is marginally suitable for salmonid production or altered to a point that stocks have shown dramatic population declines in traditional salmonid streams. If altered streams or watersheds recover their historic natural productivity, the abundant "source" populations from nearby refugia can potentially re-colonize these areas or help sustain existing salmonid populations in marginal habitat. Protection of refugia areas is noted as an essential component of salmonid conservation to ensure long-term survival of viable stocks and a critical element towards recovery of depressed salmonid populations (Sedell, 1990; Moyle and Yoshiyama 1992; Frissell 1993, 2000). Refugia habitat is defined as, areas that provide shelter or protection during times of danger or distress and locations and areas of high quality habitat that support populations limited to fragments of their former geographic range. Refugia remain as a center from which dispersion may take place to re-colonize areas after climate readjustment.

Currently there is no established methodology to designate refugia habitat for California's anadromous salmonids. This is mainly due to a lack of sufficient data describing fish populations, metapopulations and habitat productivity across large areas. This lack of information holds true for NCWAP basins especially in terms of metapopulation dynamics. Studies are needed to determine population growth rates and straying rates of salmonid populations and sub-populations to better utilize spatial population structure to identify refugia habitat.

Potential locations of refugia were determined by professional judgment, analyzing field notes, local expert opinion, habitat inventory survey results, and EMDS scores. If a habitat component received a suitable ranking from the EMDS model, it was cross-referenced to the survey results from that particular stream and to field notes taken during that survey. The components identified as potential refugia were then ranked according to their suitability to encourage and support salmonid health.

Based upon the available data from 2001, North Fork Subbasin provided the medium potential refugia in the Gualala Watershed. Potential refugia habitat was provided by canopy cover, spawning suitability, and water temperatures (Table 18).

Table 18: Refugia Categories by Subbasin, Gualala River, CA.

Subbasin	Refugia Categories:				Other Categories:		
	High Quality	High Potential	Medium Potential	Low Quality	Non-Anadromous	Critical Contributing Area	Data Limited
North Fork			X	X		X	
Rockpile				X		X	X
Buckeye				X		X	X
Wheatfield				X		X	X
Mainstem South Fork				X		X	X

8

REVIEW HABITAT DATA BY SUBBASIN

NORTH FORK SUBBASIN

Log Cabin Creek had a canopy cover over 80 percent and was not a habitat deficiency. Canopy cover on the North Fork, Little North Fork, and McGann, Robinson, Dry and Doty Creeks did not meet target values (Figure 5).

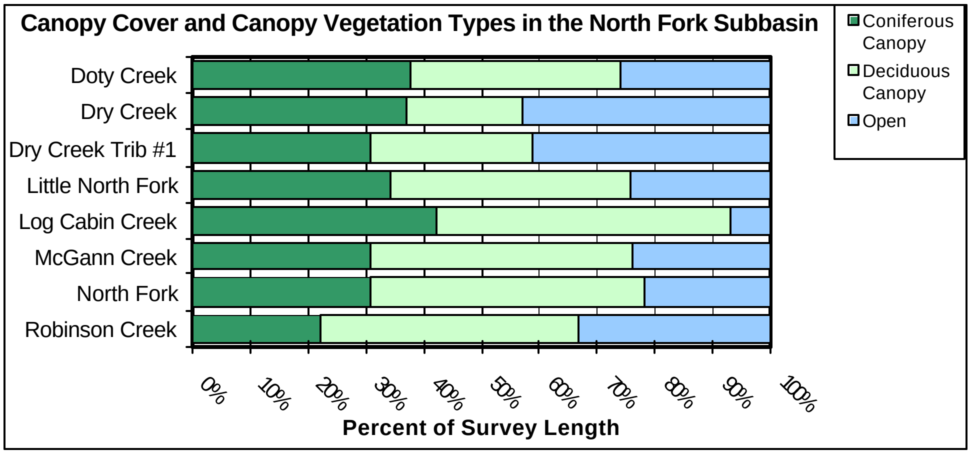

Fig. 5: Canopy Cover and Canopy Vegetation Types in the North Fork Subbasin 2001, Gualala River, CA

The GRWC measured canopy cover independent of CDFG's surveys (Fig. 6). Their method differed in that they measured in the middle of the habitat unit, whereas CDFG measured at the head (upstream end) of the unit. Canopy composition was also measured differently. GRWC calculated composition type by identifying and counting tree species in riparian plots that extended from bank full to 100 feet inland on both sides of the channel. CDFG calculated the percent vegetative composition by estimating the percent of shade each vegetation type represented in the densiometer.

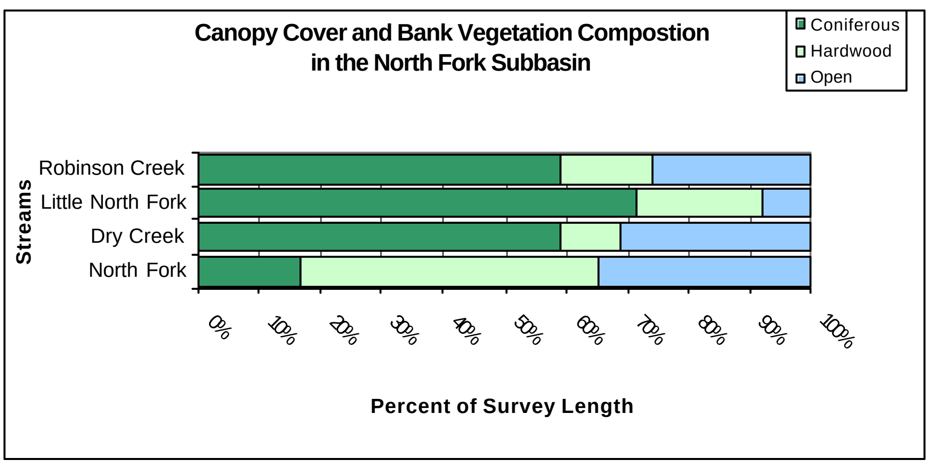

Fig. 6: Canopy Cover and Canopy Vegetation Types in the North Fork Subbasin, measured by the Gualala River Watershed Council, Gualala River, CA

Categories 1 and 2 embeddedness (<50 percent embedded) are considered the most suitable for spawning. Category 5 is unsuitable spawning substrate, which includes clay, bedrock, and logs. Embeddedness was not a habitat deficiency on Dry Creek, Dry Creek Tributary #1, Little North Fork, Log Cabin Creek, the North Fork, and Robinson Creek. Embeddedness values on both Doty Creek and McGann Creek did not met target values (Fig. 7).

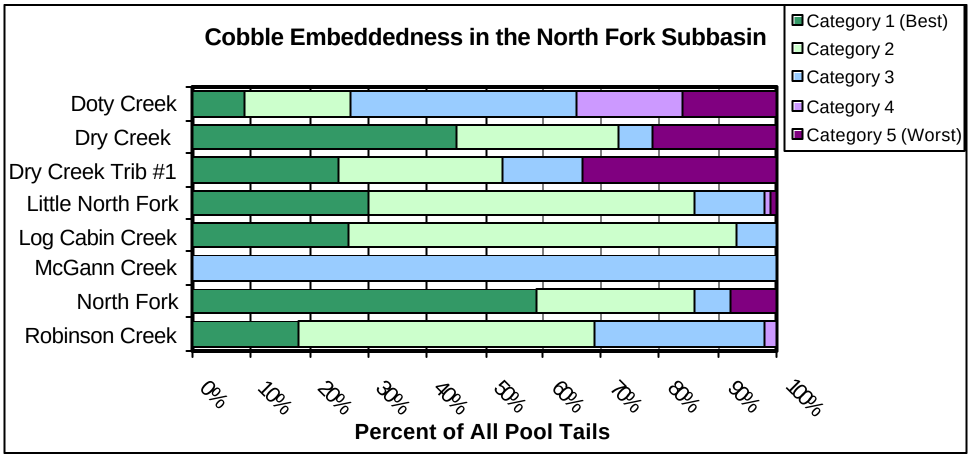

Fig. 7: Cobble Embeddedness in the North Fork Subbasin 2001, Gualala River, CA

None of the streams surveyed in the North Fork Subbasin met target values for pool depth/frequency (Fig. 8). Both the Little North Fork and North Fork had a pool frequency over 40 percent pools, meeting the frequency target value. However, neither met the depth target value based on the stream order. The Little North Fork is a second order stream with a target of 40 percent of the pools 2 feet or over. The North Fork mainstem is a third order stream with a target of 40 percent of the pools 3 feet or over.

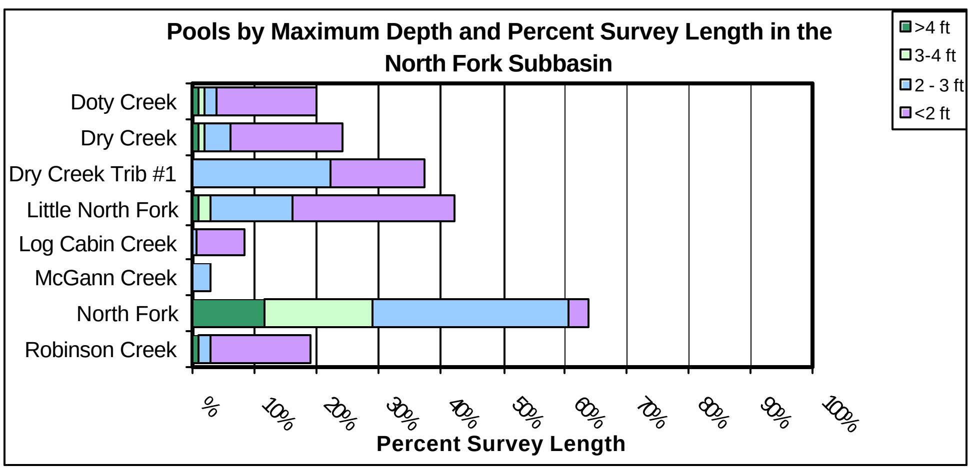

Fig. 8: Pools by maximum depth and percent survey length in the North Fork Subbasin 2001, Gualala River, CA

Shelter/cover ratings were below target values for all of the streams surveyed in the North Fork Subbasin (Fig. 9). The top three types of shelter/cover provided were small woody debris, large woody debris and boulders (Fig. 10). Small woody debris, large woody debris, and boulders provided most of the shelter on Doty and Dry creeks. Small woody debris, large woody debris, and root mass provided most of the shelter on the Little North Fork. Small woody debris, undercut banks, and root mass provided most of the shelter on Log Cabin Creek. Most of the shelter was provided by undercut banks, root mass and aquatic vegetation on McGann Creek. Small woody debris, terrestrial vegetation, and boulders provided most of the shelter on the North Fork. Small woody debris, large woody debris, and undercut banks provided most of the shelter on Robinson Creek

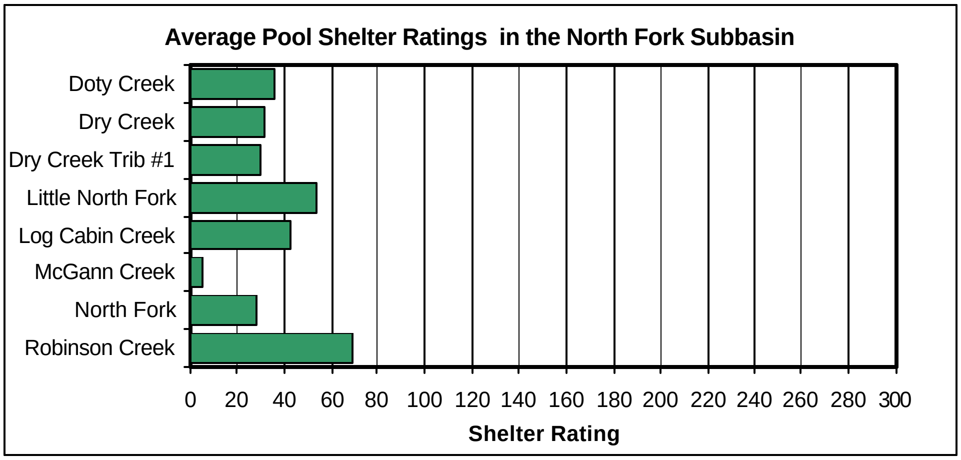

Fig 9: Average pool shelter ratings in the North Fork Subbasin 2001, Gualala River, CA.

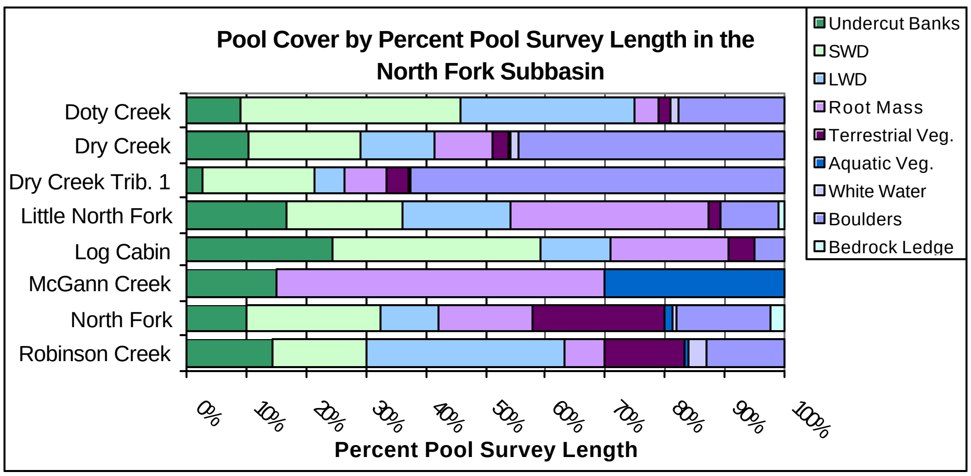

Fig. 10: Pool cover by percent of pool survey length in the North Fork Subbasin 2001, Gualala River, CA.

Dominant substrate by survey length presents a general picture of the sediment moving through the stream system. All of the streams surveyed were dominated by gravel.

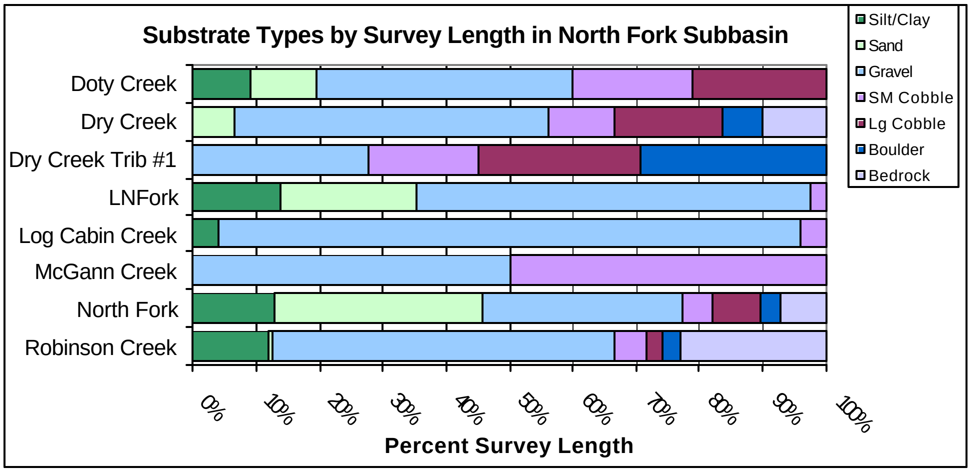

Fig. 11: Dominant substrate by percent survey length in the North Fork Subbasin 2001, Gualala River, CA

ECOLOGICAL MANAGEMENT DECISION SUPPORT

The EMDS model showed that canopy density was moderately suitable on the North Fork and fully suitable on the Little North Fork and Doty Creek (Table 19). Robinson and Dry Creeks were somewhat unsuitable. Embeddedness was moderately suitable on the North Fork, moderately to somewhat suitable on the Little North Fork and Dry Creek. Robinson Creek was found somewhat unsuitable. Doty Creek was found unsuitable. The EMDS model combined pool depth with pool shelter to rate overall pool quality. Pool depth was fully suitable on the North Fork and fully unsuitable on all other tributaries inventoried. Pool shelter was fully unsuitable on the North Fork and Dry Creek, somewhat unsuitable on Doty Creek and somewhat suitable on the Little North Fork and Robinson Creek. Overall pool quality was undetermined on the North Fork, moderately unsuitable on the Little North Fork and Doty Creek, somewhat unsuitable on Robinson, and fully unsuitable on Dry Creek. Data collected on tributaries less than one mile in length were not included.

Table 19: Ecological Management Decision Support (EMDS) Reach Model Scores on salmonid health and productivity suitability for the Gualala Basin, CA, based upon habitat inventory surveys conducted in 1999 and 2001.

The 2001 water temperature data was provided by GRI and the GRWC +++ =Fully Suitable; ++ = Moderately Suitable; + = Somewhat Suitable; U= Undetermined- = Somewhat Unsuitable; - - = Moderately Unsuitable; --- =Fully Unsuitable

Subbasin / Stream Scores	Canopy Cover Score	Embeddedness Score	Pool Depth Score	Pool Shelter Score	Pool Quality Score	2001MWAT Water Temp% Score
North Fork Subbasin	+	+	+	--	-	
Doty Creek	+++	-	---	--	--	
Dry Creek	-	++	---	---	---	+++
Dry Creek Trib #1	-	+	---	--	--	
Little North Fork	+++	++	---	--	--	+++
LNF Trib #1	+++	+	--	--	--	
Log Cabin Creek	+++	+	---	--	--	

Subbasin / Stream Scores	Canopy Cover Score	Embeddedness Score	Pool Depth Score	Pool Shelter Score	Pool Quality Score	2001MWAT Water Temp% Score
McGann Creek	++	---	---	---	---	
North Fork	++	++	+++	---	U	U
Robinson Creek	-	-	---	+	-	+++

LIMITING FACTORS ANALYSIS

The lack of pool shelter/cover was the predominant limiting factor in the North Fork Subbasin, followed by pool depth, and canopy cover (Table 20). Pool depth was the predominant limiting factor on most of the streams surveyed with the lack of pool shelter/cover being a close second. Embeddedness was limiting on both Doty and McGann creeks. Canopy cover was a limiting factor on Robinson and Dry Creeks.

Table 20: Limiting factors affecting salmonid health and production based upon habitat inventory surveys conducted in 1999 and 2001 and EMDS scores in the Gualala Basin, CA. Rank 1 is the greatest limiting factor.

Subbasin Stream Score	Canopy Cover Related to Water Temperature	Embeddedness Related to Spawning Suitability	Pool Depth Related to Summer Conditions	Pool Shelter Related to Escape and Cover
North Fork Subbasin				
Doty Creek		**3**	**1**	**2**
Dry Creek	**3**	**4**	**1**	**2**
Dry Creek Trib. # 1	**3**		**1**	**2**
Little North Fork			**1**	**2**
LNF Trib. # 1			**1**	**2**
Log Cabin Creek			**1**	**2**
McGann Creek		**3**	**2**	**1**
North Fork				**1**
Robinson Creek	**2**		**1**	

POTENTIAL REFUGIA

Medium Potential Refugia was identified in both of the North Fork and Little North Fork (Table 21). Scores are based upon professional judgment, local expertise, habitat inventory surveys conducted in 1999 and 2001 and Ecological Management Decision Support scores.

Table 21: Refugia Categories for Surveyed Tributaries in the North Fork Subbasin, Gualala River, CA.

Subbasin	Stream	Refugia Categories:				Other Categories:		
		High Quality	High Potential	Medium Potential	Low Quality	Non-Anadromous	Critical Contributing Area	Data Limited
North Fork	North Fork			X			X	
	Little North Fork			X			X	
	Robinson Creek				X		X	

Subbasin	Stream	Refugia Categories:				Other Categories:		
		High Quality	High Potential	Medium Potential	Low Quality	Non-Anadromous	Critical Contributing Area	Data Limited
	McGann Creek				X		X	
	Dry Creek				X		X	
	Doty Creek				X		X	
	Log Cabin Creek				X			

ROCKPILE SUBBASIN

Rockpile Creek is a second order stream. The habitat inventory survey data showed habitat deficiencies related to canopy cover, pool frequency/depth, and shelter cover. Canopy cover was 55 percent in the lower 8.5 miles with conifers contributing 15 percent and deciduous 40 percent (Fig. 12). Target values for embeddedness were reached in >50% in the 8.5 miles surveyed. Fifty-two percent of pool tails surveyed in were category 1 or 2 embeddedness (Fig. 13). Twenty-two percent of the survey length consisted of primary pools (Fig. 14). Pool shelter/cover values target values were not met in the 8.5 miles surveyed. Shelter/cover received a rating of 41 (Fig. 15), and most of the cover was provided by undercut banks, large woody debris, and root masses (Fig. 16). Dominant substrate by survey length presents a general picture of the sediment moving through the stream system. Rockpile Creek is dominated by gravel and sand in the 8.5 miles surveyed (Fig. 17).

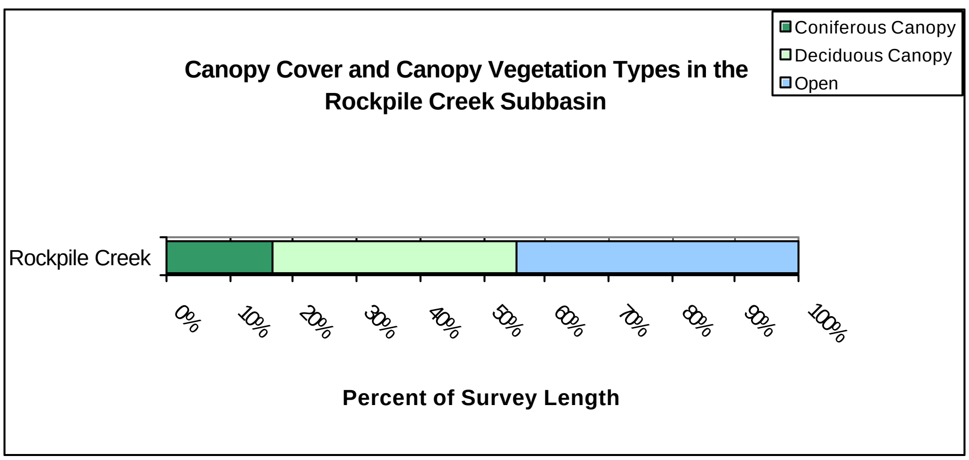

Fig. 12: Canopy cover and canopy vegetation types by percent survey length in the Rockpile Creek, Rockpile Subbasin 2001, Gualala River, CA.

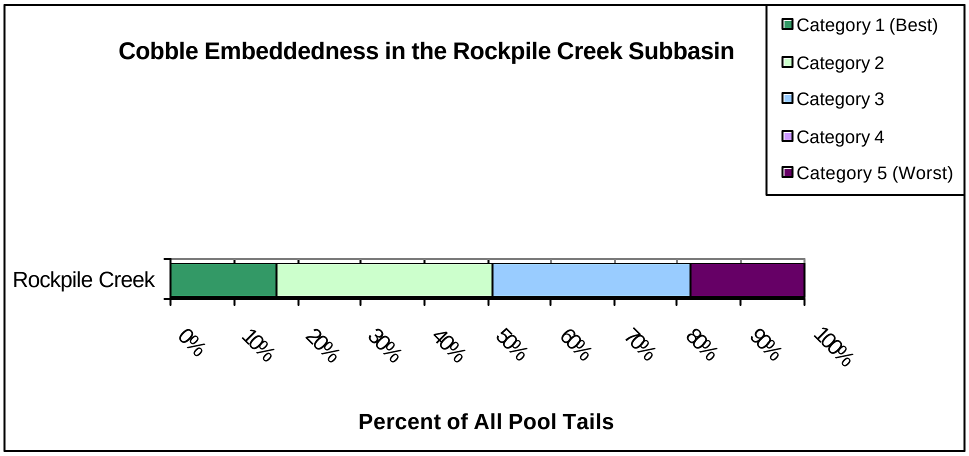

Fig. 13: Cobble embeddedness in the Rockpile Creek Subbasin 2001, Gualala River, CA.

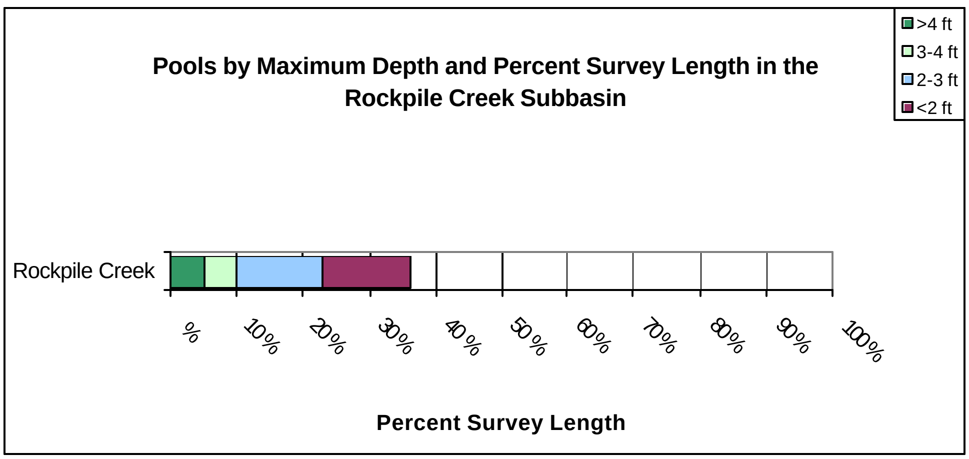

Fig. 14: Pools by maximum depth and percent survey length in the Rockpile Creek Subbasin 2001, Gualala River, CA.

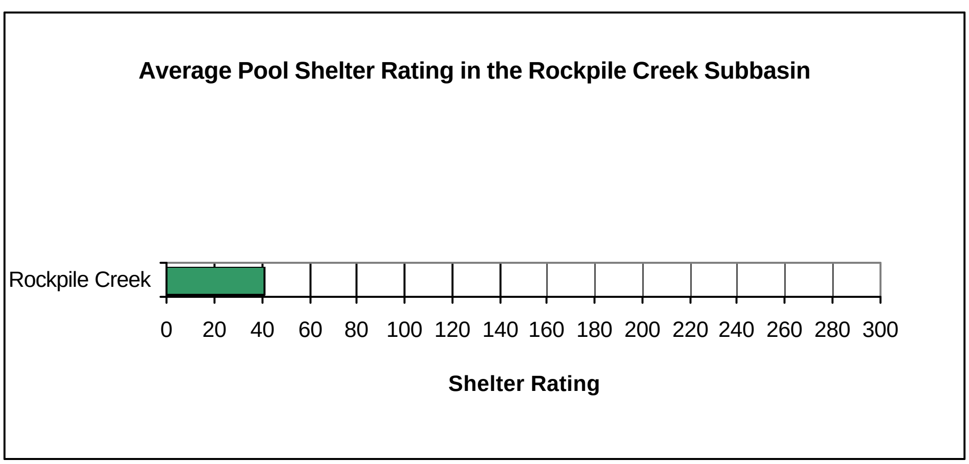

Fig. 15: Average pool shelter ratings in the Rockpile Creek Subbasin 2001, Gualala River, CA.

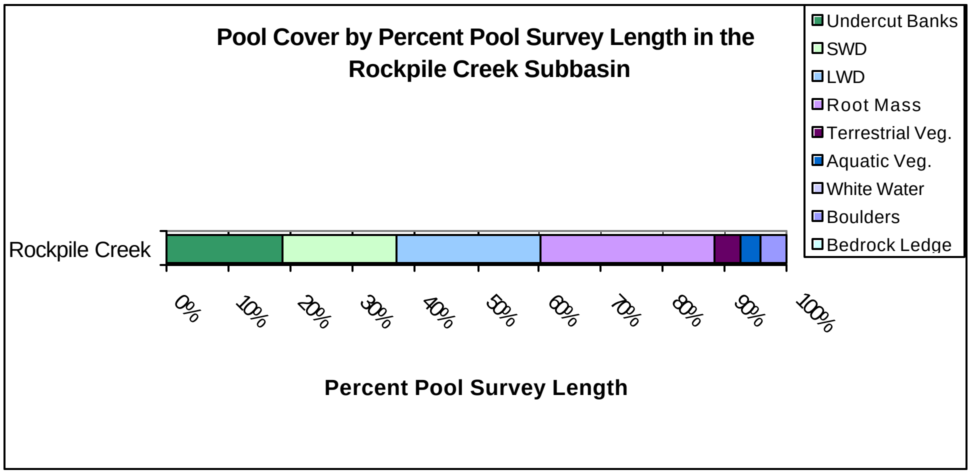

Fig. 16: Pool cover by percent of pool survey length in the Rockpile Creek Subbasin 2001, Gualala River, CA.

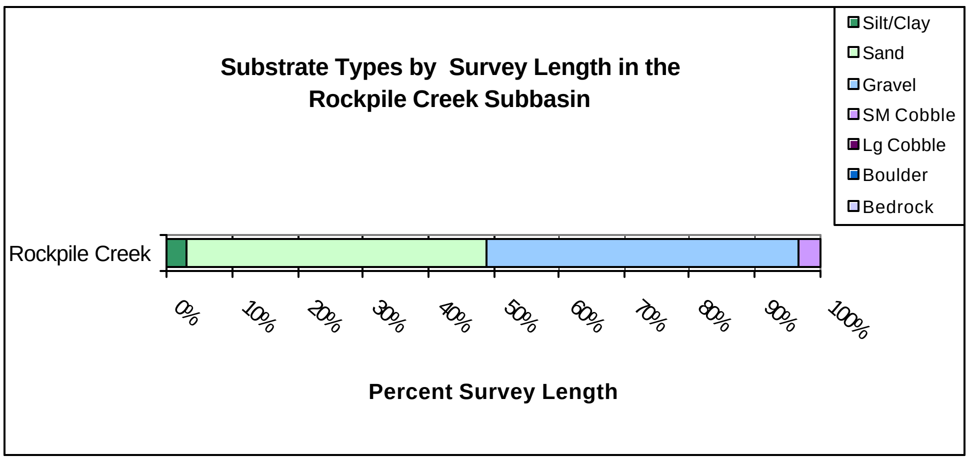

Fig. 17: Dominant substrate by percent survey length in the Rockpile Creek Subbasin 2001, Gualala River, CA.

ECOLOGICAL MANAGEMENT DECISION SUPPORT

The EMDS model showed that canopy density was fully unsuitable and embeddedness was somewhat suitable. The EMDS model combined pool depth with pool shelter to rate overall pool quality. Pool depth was fully unsuitable. Pool shelter was somewhat suitable. Overall pool quality was moderately unsuitable (Table 21).

Table 21: Ecological Management Decision Support (EMDS) Reach Model Scores on salmonid heath and productivity suitability for the Gualala Basin, CA, based upon habitat inventory surveys conducted in 1999 and 2001. The 2001 water temperature data was provided by GRI and the GRWC.

+++ =Fully Suitable; ++ = Moderately Suitable; + = Somewhat Suitable; U= Undetermined- = Somewhat Unsuitable; - - = Moderately Unsuitable; --- =Fully Unsuitable

Subbasin Stream Scores	Canopy Cover Score	Embeddedness Score	Pool Depth Score	Pool Shelter Score	Pool Quality	2001MWAT Water Temp% Score
Rockpile Subbasin	--	-	---	--	--	
Rockpile Creek	--	-	---	--	--	-

LIMITING FACTORS ANALYSIS

The lack of pool depth was the predominant limiting factor in Rockpile Creek, followed by pool shelter/cover, canopy cove and embeddedness (Table 22).

Table 22: Limiting factors affecting salmonid health and production based upon habitat inventory surveys conducted in 1999 and 2001 and EMDS scores in the Gualala Basin, CA.

Rank 1 is the greatest limiting factor.

Subbasin Stream Score	Canopy Cover Related to Water Temperature	Embeddedness Related to Spawning Suitability	Pool Depth Related to Summer Conditions	Pool Shelter Related to Escape and Cover
Rockpile Subbasin				
Rockpile Creek	**3**	**4**	**1**	**2**

POTENTIAL REFUGIA

Refugia was not identified in Rockpile Creek (Table 23). Scores are based upon professional judgment, local expertise, habitat inventory surveys conducted in 1999 and 2001 and Ecological Management Decision Support scores.

Table 23: Refugia Categories for Surveyed Tributaries in the Rockpile Subbasin, Gualala River, CA.

		Refugia Categories:				Other Categories:		
Subbasin	**Stream**	**High Quality**	**High Potential**	**Medium Potential**	**Low Quality**	**Non-Anadromous**	**Critical Contributing Area**	**Data Limited**
Rockpile	Rockpile Creek				X		X	X

BUCKEYE SUBBASIN

Buckeye Creek is a third order stream. The habitat inventory survey data showed that target values were not met for canopy cover, pool frequency/depth and shelter cover. Target values for canopy cover were not met. Canopy cover averaged 61 percent with conifers contributing 37 percent and deciduous 24 percent (Fig. 18). Target values for embeddedness were met. Sixty-nine percent of pool tails surveyed in were category 1 or 2 embeddedness (Fig. 19). Target values for pool frequency/depth were not met. Buckeye Creek showed 11 percent of the survey length consisted of primary pools (Fig. 20). Target values for pool shelter/cover were not met. Shelter/cover received a rating of 44 (Fig. 21), and the cover was provided by large and small woody debris, boulders and root masses (Fig. 22). Dominant substrate by survey length presents a general picture of the sediment moving through the stream system. Buckeye Creek is dominated by gravel (Fig. 23).

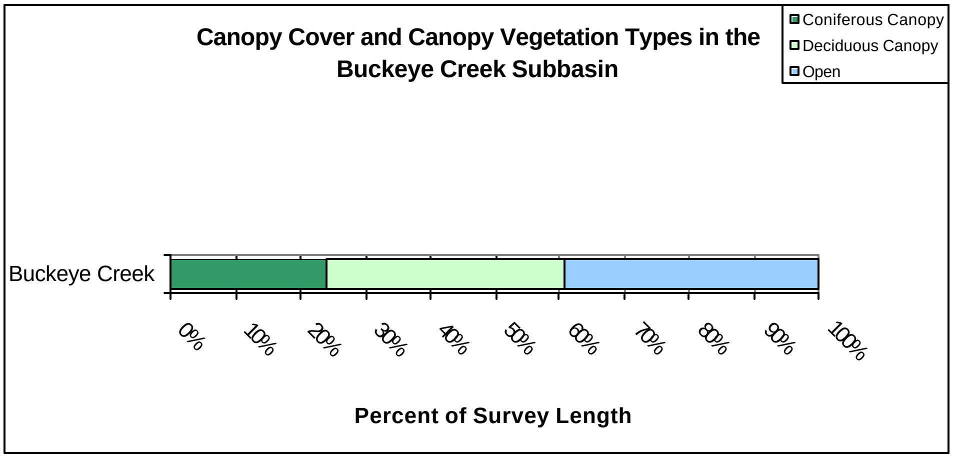

Fig. 18: Canopy cover and canopy vegetation types by percent survey length in the Buckeye Creek, Buckeye Subbasin 2001, Gualala River, CA.

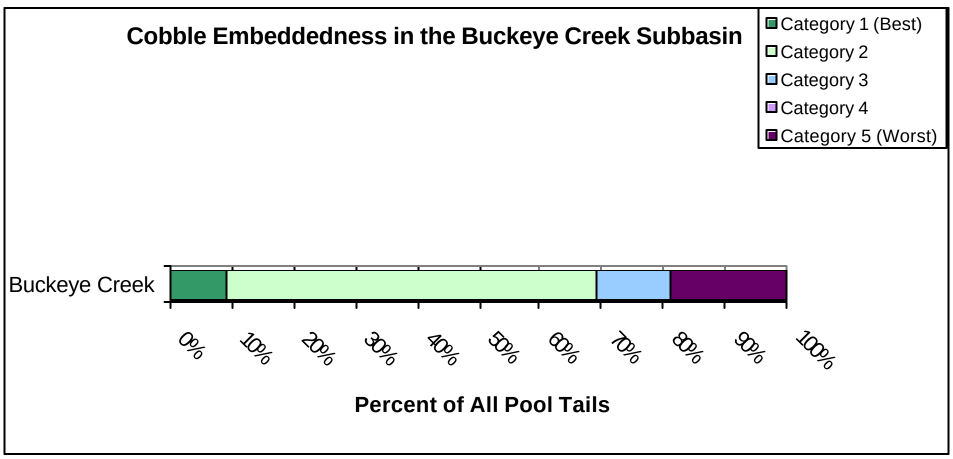

Fig. 19: Percent of cobble embeddedness in all pool tails in the Buckeye Creek Subbasin 2001, Gualala River, CA

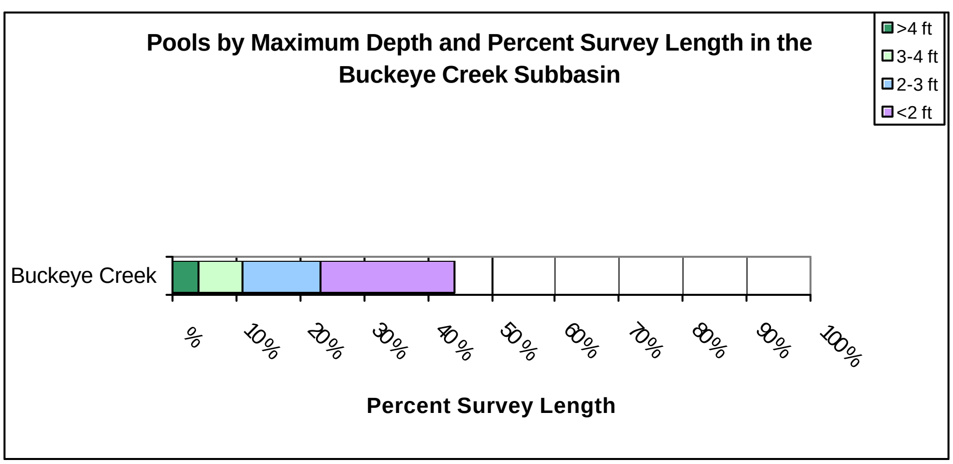

Fig. 20: Pools by maximum depth and percent survey length in the Buckeye Creek Subbasin 2001, Gualala River, CA.

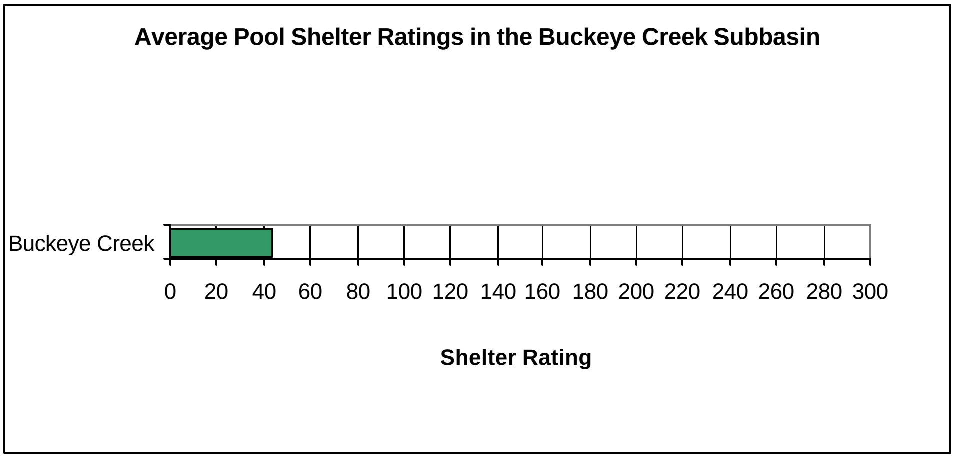

Fig. 21: Average pool shelter ratings in the Buckeye Creek Subbasin 2001, Gualala River, CA.

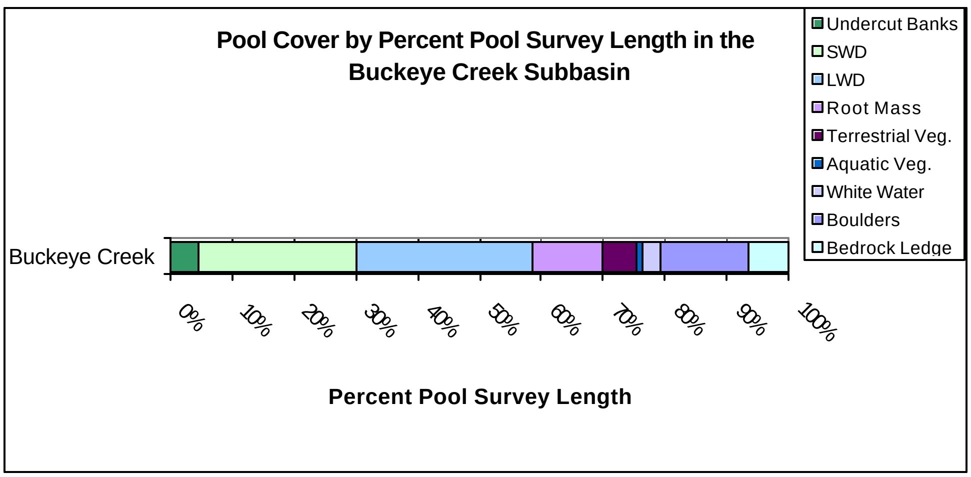

Fig. 23: Pool cover types by percent of pool survey length in the Buckeye Creek Subbasin 2001, Gualala River, CA.

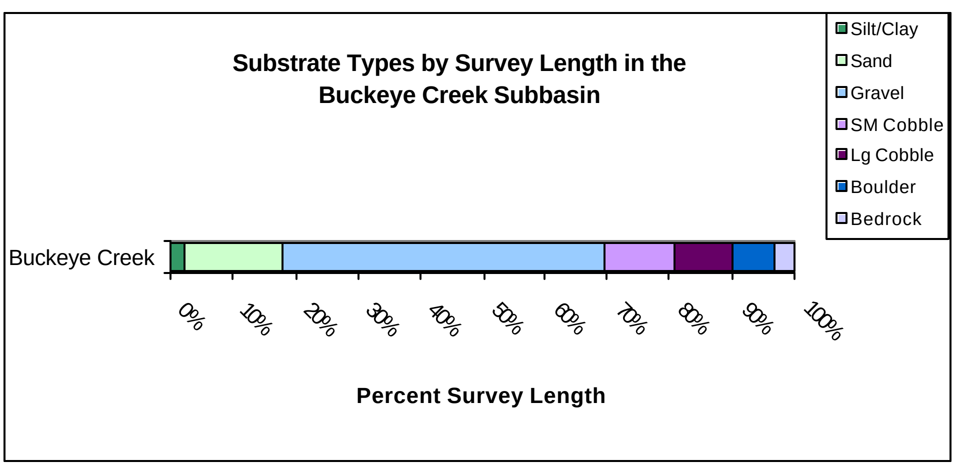

Fig. 24: Dominant substrate by percent survey length in Buckeye Creek Subbasin 2001, Gualala River, CA

ECOLOGICAL MANAGEMENT DECISION SUPPORT

The EMDS model showed that canopy density was somewhat suitable to moderately unsuitable and embeddedness was somewhat unsuitable to somewhat suitable on that part of Buckeye Creek (Table 24). The EMDS model combined pool depth with pool shelter to rate overall pool quality. Pool depth was fully to moderately unsuitable. Pool shelter was somewhat suitable. Overall pool quality was moderately to somewhat unsuitable.

Table 24: Ecological Management Decision Support (EMDS) Reach Model Scores on salmonid heath and productivity suitability for the Gualala Basin, CA, based upon habitat inventory surveys conducted in 1999 and 2001.

+++ =Fully Suitable; ++ = Moderately Suitable; + = Somewhat Suitable; U= Undetermined- = Somewhat Unsuitable; - - = Moderately Unsuitable; --- =Fully Unsuitable

Subbasin Stream **Scores**	**Canopy Cover Score**	**Embeddedness Score**	**Pool Depth Score**	**Pool Shelter Score**	**Pool Quality**	**2001MWAT Water Temp% Score**
Buckeye Subbasin	-	+	--	-	-	
Buckeye Creek	-	-	--	-	-	--

LIMITING FACTORS ANALYSIS

The lack of pool depth was the predominant limiting factor in Buckeye Creek, followed by pool shelter/cover, canopy cover and embeddedness (Table 25).

Table 25: Limiting factors affecting salmonid health and production based upon habitat inventory surveys conducted in 1999 and 2001 and EMDS scores in the Gualala Basin, CA.

Subbasin Stream **Score**	**Canopy Cover Related to Water Temperature**	**Embeddedness Related to Spawning Suitability**	**Pool Depth Related to Summer Conditions**	**Pool Shelter Related to Escape and Cover**
Buckeye Subbasin				
Buckeye Creek	**3**	**4**	**1**	**2**

POTENTIAL REFUGIA

Refugia was not identified in Buckeye Creek (Table 26). Scores are based upon professional judgment, local expertise, habitat inventory surveys conducted in 1999 and 2001 and Ecological Management Decision Support scores.

Table 26: Refugia Categories for Surveyed Tributaries in the Buckeye Subbasin, Gualala River, CA.

		Refugia Categories:				**Other Categories:**		
Subbasin	**Stream**	**High Quality**	**High Potential**	**Medium Potential**	**Low Quality**	**Non-Anadromous**	**Critical Contributing Area**	**Data Limited**
Buckeye	Buckeye Creek				X		X	

WHEATFIELD SUBBASIN

Canopy cover target value were not met on any of the streams surveyed in the Wheatfield Subbasin except Sullivan Creek. The subbasin canopy cover values ranged from 21 to 89 percent Fork (Fig. 25).

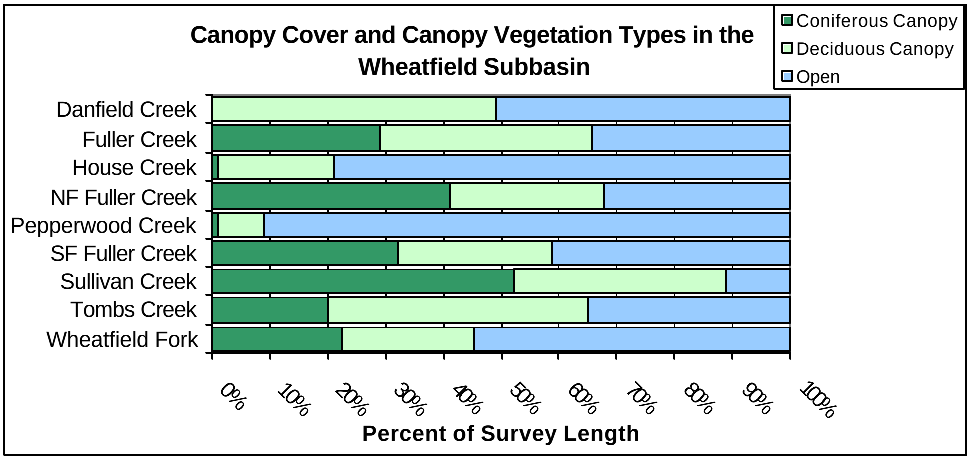

Fig. 24: Canopy cover and canopy vegetation types by percent survey length in nine tributaries, Wheatfield Subbasin 1995 & 2001, Gualala River, CA

Embeddedness target values were met on House, Pepperwood, Sullivan, and Tombs Creeks and the Wheatfield Fork. Categories 1 and 2 embeddedness (<50 percent embedded) are considered the most productive for spawning. Category 5 is unsuitable substrate, which includes materials such as clay, bedrock, and log. Data collected during 1995 and 2001 habitat inventory surveys showed that House, Pepperwood, Sullivan, and Tombs Creeks and the Wheatfield Fork had greater than 50 percent of all pool tails surveyed that were category 1 and 2. Less than 5 percent of surveyed pool tails were category 1 and 2 on Fuller Creek and less than 30 percent on the North and South Forks of Fuller Creek and Danfield Creek (Fig. 25).

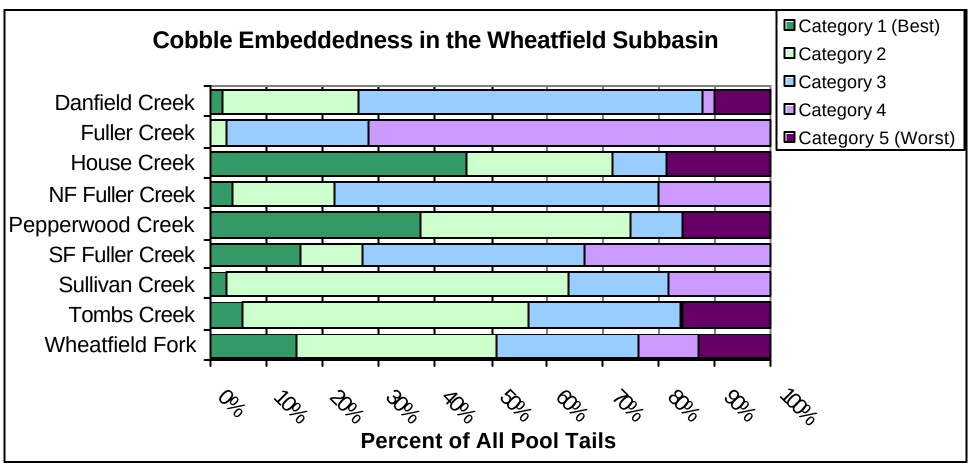

Fig. 25: Percent of cobble embeddedness in all pool tails in the lower Wheatfield Subbasin 1995 and 2001, Gualala River, CA.

Not all streams surveyed in the Wheatfield Subbasin met target values for pool frequency/depth (Fig. 26).

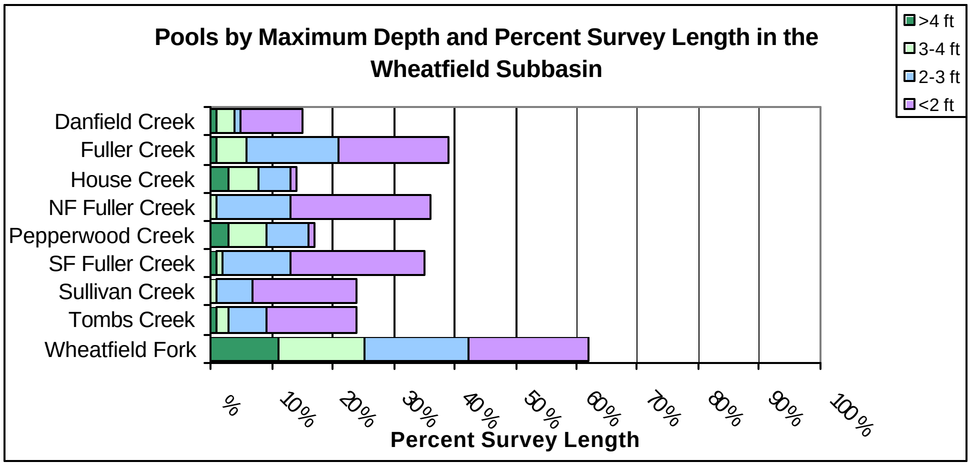

Fig. 26: Pools by maximum depth and percent survey length in the lower Wheatfield Subbasin 1995 and 2001, Gualala River, CA.

Shelter/Cover ratings were below the target values for all of the streams surveyed in the Wheatfield Fork Subbasin (Fig. 27). The top three types of shelter/cover provided were boulders, large woody debris and terrestrial vegetation (Fig. 28). The primary cover types were root mass, boulders, and bedrock ledge on Danfield Creek. The primary cover types were undercut banks, large woody debris, and terrestrial vegetation on Fuller Creek. The primary cover types were boulders, root mass, and bedrock ledge on House Creek. North Fork Fuller and South Fork Fuller creeks primary cover types were undercut banks, large woody debris, and boulders. The primary cover types were boulders, bedrock ledge, and aquatic vegetation on Pepperwood Creek. The primary cover types were undercut banks, small woody debris, and large woody debris on Sullivan Creek. The primary cover types were small woody debris, white water, and boulders on Tombs Creek. The primary cover types were small woody debris, terrestrial vegetation and boulders on the Wheatfield Fork.

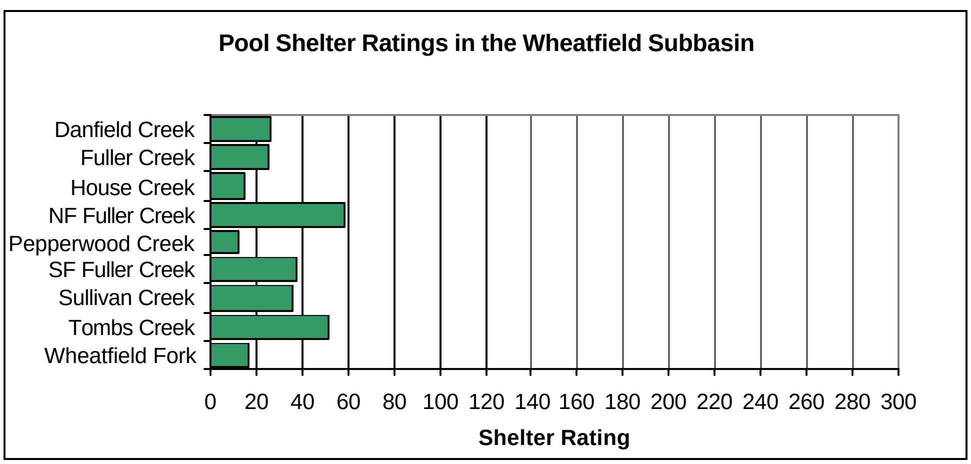

Fig. 27: Average pool shelter ratings in the Wheatfield Subbasin 1995 and 2001, Gualala River, CA.

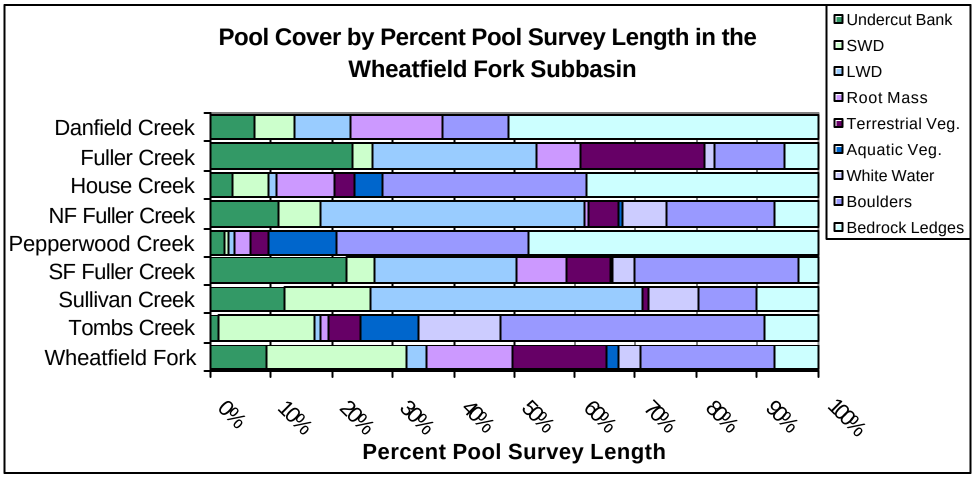

Fig. 28: Pool cover types by percent of pool survey length in the lower Wheatfield Subbasin 1995 and 2001, Gualala River, CA.

Dominant substrate by survey length presents a general picture of the sediment moving through the stream system. Gravel dominated the subbasin were surveyed (Fig. 29).

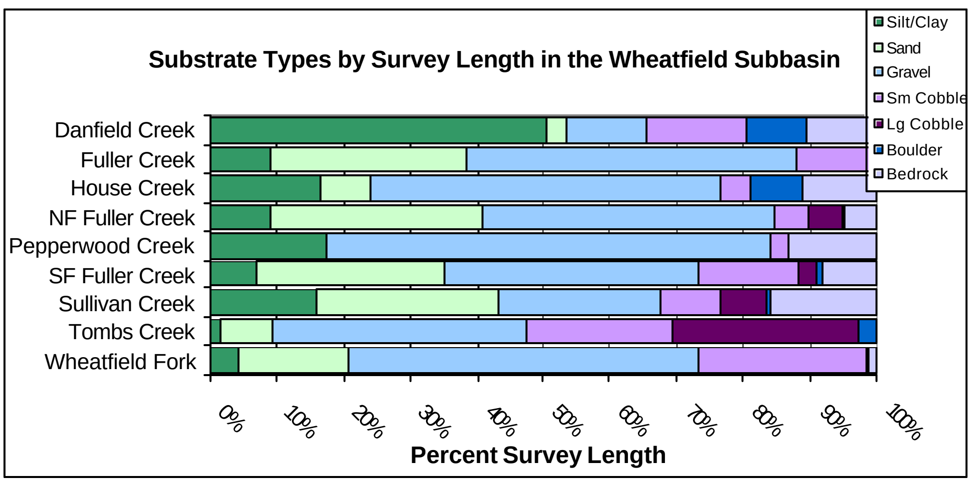

Fig. 29: Dominant substrate by percent survey length in the lower Wheatfield Subbasin 1995 and 2001, Gualala River, CA.

ECOLOGICAL MANAGEMENT DECISION SUPPORT

The EMDS model showed that canopy density was fully unsuitable and embeddedness was somewhat to fully unsuitable on the 22 miles of the Wheatfield surveyed. The EMDS model combined pool depth with pool shelter to rate overall pool quality. Pool depth was fully suitable and pool shelter was fully unsuitable on the 22 miles of the Wheatfield Fork surveyed. Overall pool quality was undetermined, and moderately to fully unsuitable on the Wheatfield Fork. Data collected on tributaries less than one mile in length were not included. On Tomb's Creek, EMDS model showed that canopy density was fully unsuitable and that embeddedness was somewhat unsuitable. The EMDS model combined pool depth with pool shelter to rate overall pool quality. Pool depth was fully unsuitable. Pool shelter was somewhat unsuitable. Overall pool quality was moderately unsuitable. The EMDS model showed that canopy density was fully unsuitable on House, Danfield and Pepperwood Creeks. The EMDS model showed that embeddedness was somewhat to moderately suitable on all three creeks and pool depths and pool shelter were fully unsuitable on all three creeks. Overall pool quality was fully unsuitable (Table 27).

Table 27: Ecological Management Decision Support (EMDS) Reach Model Scores on salmonid heath and productivity suitability for the Gualala Basin, CA, based upon habitat inventory surveys conducted in 1999 and 2001.

+++ =Fully Suitable; ++ = Moderately Suitable; + =Somewhat Suitable; U= Undetermined- = Somewhat Unsuitable; - - = Moderately Unsuitable; --- =Fully Unsuitable

Subbasin Stream **Scores**	Canopy Cover Score	Embeddedness Score	Pool Depth Score	Pool Shelter Score	Pool Quality	2001MWAT Water Temp% Score
Wheatfield Subbasin	--	-	-	--	-	
Danfield Creek	---	--		---	---	
House Creek	---	++	---	U	--	
Pepperwood Creek	---	+	---	---	---	
Tombs Creek	-	-	---	-	--	
Wheatfield Fork	--	-	+	---	-	---

LIMITING FACTORS ANALYSIS

The lack of canopy cover was the predominant limiting factor for the streams habitat inventoried in 2001 (Table 28) and embeddedness was the predominant limiting factor for the streams habitat inventoried in 1995 (Table 29).

Table 28: Limiting factors affecting salmonid health and production based upon habitat inventory surveys conducted in 1999 and 2001 and EMDS scores in the Gualala Basin, CA.

Rank 1 is the greatest limiting factor.

Subbasin Stream **Score**	Canopy Cover Related to Water Temperature	Embeddedness Related to Spawning Suitability	Pool Depth Related to Summer Conditions	Pool Shelter Related to Escape and Cover
Wheatfield Fork Subbasin				
Danfield Creek	1	4	3	2
House Creek	1	4	3	2
Pepperwood Creek	1	4	3	2
Tombs Creek	2	4	1	3
Wheatfield Fork	2	3		1

Table 29: Limiting factors affecting salmonid health and production in the Fuller Creek watershed located in the Wheatfield Subbasin of the Gualala River, CA, based upon habitat inventory surveys conducted in 1995.

Rank of 1 is most limiting factor.

Watershed Stream Name **Score**	Canopy Related to Water Temperature	Embeddedness Related to Spawning Suitability	Pool Depth Related to Summer Conditions	Pool Shelter Related to Escape and Cover
Fuller Creek	4	1	2	3
N F Fuller Creek	4	1	2	3
S F Fuller Creek	4	1	2	3

Sullivan Creek		**3**	**1**	**2**

POTENTIAL REFUGIA

Refugia was not identified in the Wheatfield Subbasin (Table 30). Scores are based upon professional judgment, local expertise, habitat inventory surveys conducted in 1999 and 2001 and Ecological Management Decision Support scores.

Table 30: Refugia Categories for Surveyed Tributaries in the Wheatfield Subbasin Gualala River, CA.

		Refugia Categories:				Other Categories:		
Subbasin	**Stream**	**High Quality**	**High Potential**	**Medium Potential**	**Low Quality**	**Non-Anadromous**	**Critical Contributing Area**	**Data Limited**
Wheatfield	Wheatfield Fork				X		X	
	Haupt Creek				X		X	X
	Fuller Creek				X		X	
	NF Fuller Creek				X			
	SF Fuller				X			
	Sullivan Creek				X		X	
	Tombs Creek				X			
	House Creek				X		X	
	Pepperwood Creek				X		X	
	Danfield Creek				X			

MAINSTEM/SOUTH FORK SUBBASIN

Canopy coverage did not meet target values on Marshall, McKenzie, and Wild Hog Creeks. Most of the canopy was dominated by deciduous tree species (Figure 30).

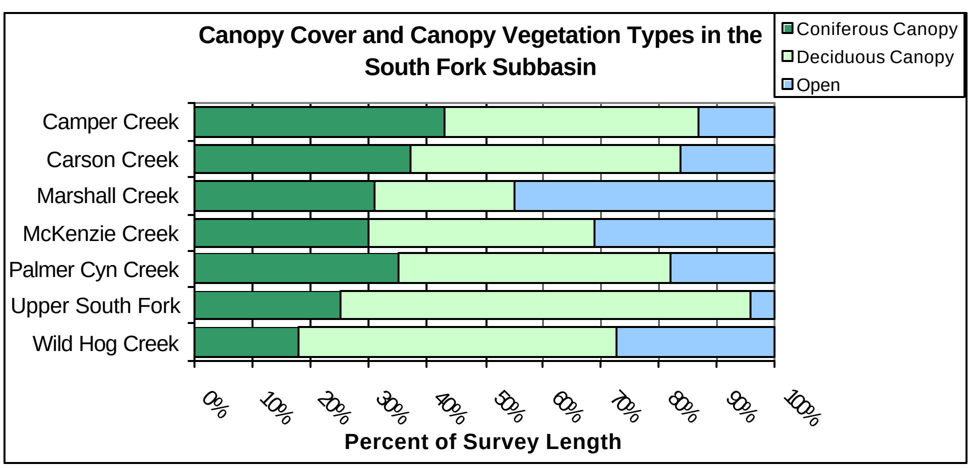

Fig. 30: Canopy cover and canopy vegetation types in the seven tributaries surveyed, South Fork Subbasin 1999 and 2001, Gualala River, CA.

All of the streams surveyed except Carson Creek met the target values for embeddedness. Categories 1 and 2 embeddedness (<50 percent embedded) are considered the most productive for spawning. Category 5 is unsuitable substrate, which includes clay, bedrock, and logs. Data collected during 1999 and 2001 habitat inventory surveys showed that all streams, except Carson Creek, had greater than 50 percent of the pool tails surveyed in categories 1 and 2. Slightly less than 50percent of the pool tails surveyed on Carson Creek were categories 1 and 2 (Fig. 31). Not all of the streams surveyed in the Main Stem/South Fork Subbasin met target values for pool/frequency (Fig. 32).

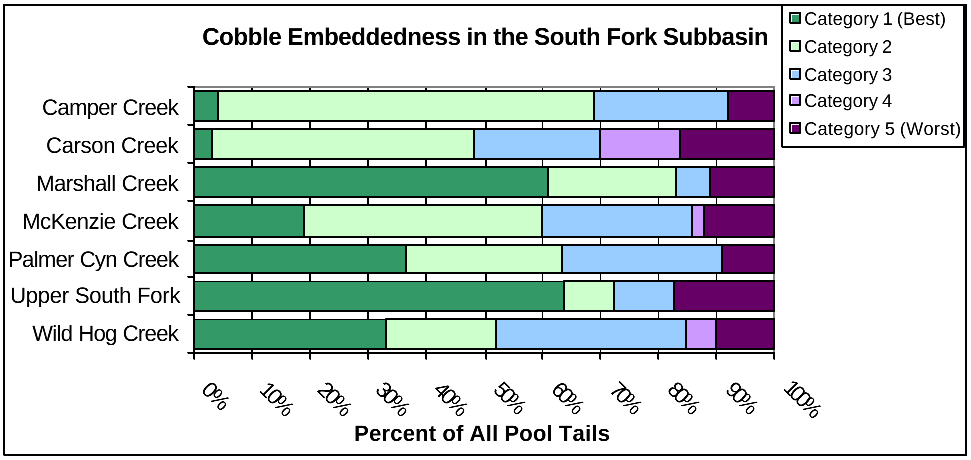

Fig. 31: Cobble embeddedness in the South Fork Subbasin 1999 2001, Gualala River, CA.

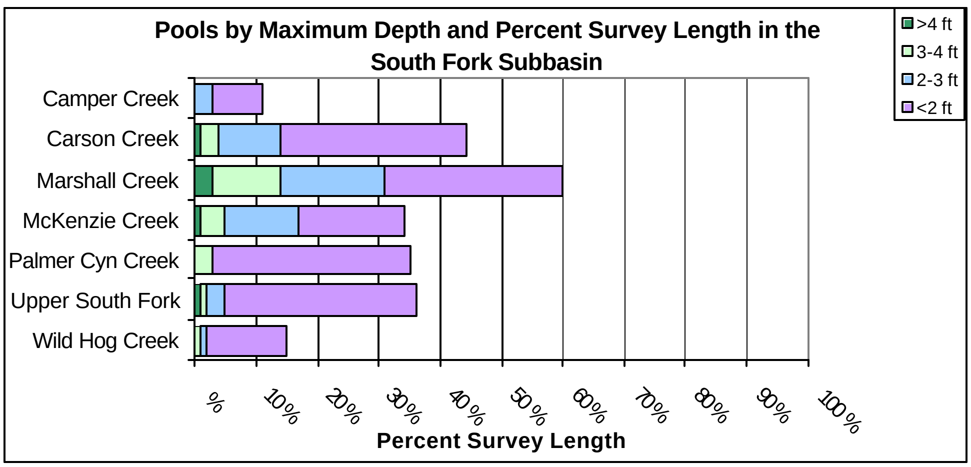

Fig. 32: Pools by maximum depth and percent survey length in the South Fork Subbasin 1999 and 2001, Gualala River, CA

Shelter/cover ratings were below target values for all of the streams surveyed in the South Fork Subbasin (Fig. 33). The top three types of shelter/cover were mostly bedrock ledges, small woody debris, and large woody debris. Small woody debris, boulders, and bedrock ledge provided the most shelter on Camper Creek. The primary cover types were undercut banks, root mass, and white water on Carson Creek The primary cover types were small woody debris, root mass, and bedrock ledge on Marshall Creek. The primary cover types were boulders, large woody debris, and root masses on McKenzie Creek. On Palmer Canyon Creek, boulders, small woody debris, and aquatic vegetation provided the most shelter. The primary cover types were small woody debris, boulders, and bedrock ledge on Upper South Fork. Large woody debris and bedrock ledge provided the most shelter on Wild Hog Creek (Fig. 34).

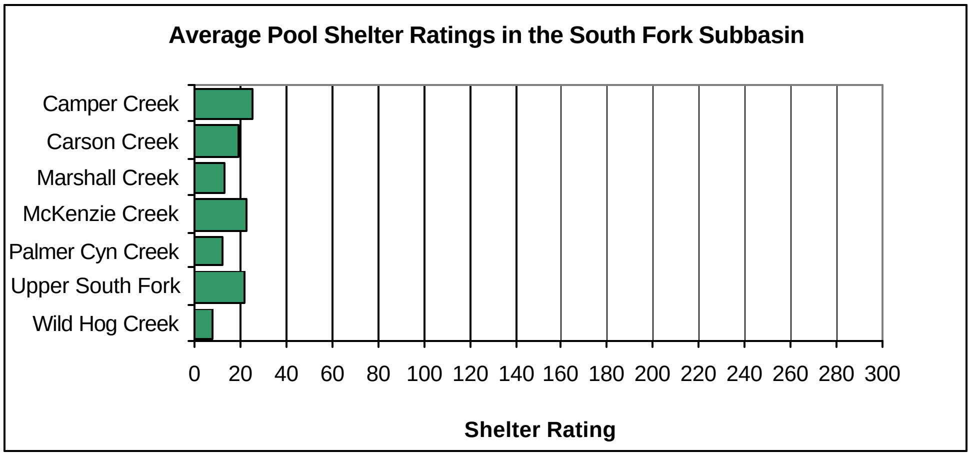

Fig. 33: Average pool shelter ratings in the South Fork Subbasin 1999 and 2001, Gualala River, CA.

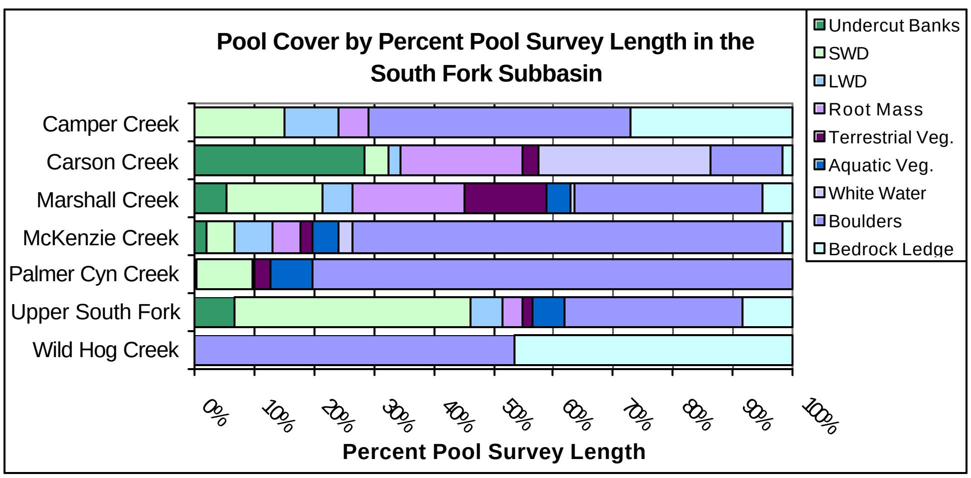

Fig. 34: Pool cover types by percent of pool survey length in the South Fork.

Dominant substrate by survey length presents a general picture of the sediment moving through the stream system. The Main Stem and South Fork Subbasin is dominated by gravel were surveys were conducted (Fig. 35).

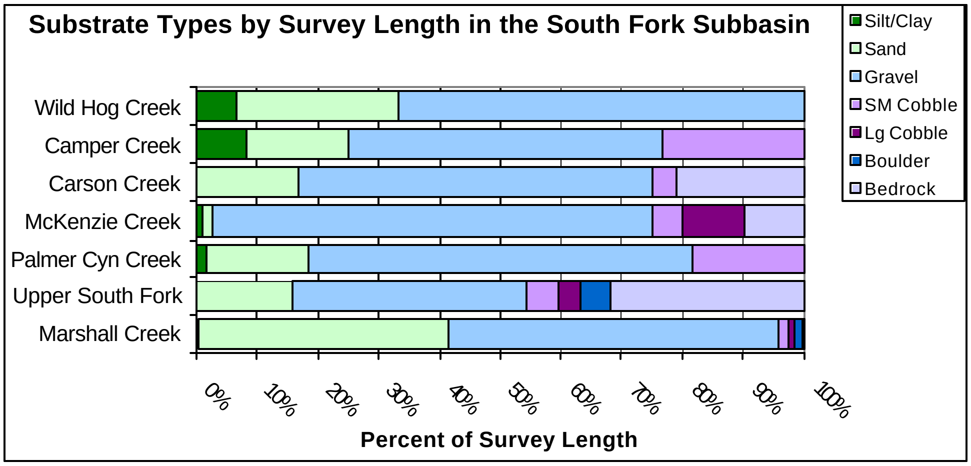

Fig. 35: Dominant substrate by percent survey length in the South Fork Subbasin 1999 and 2001, Gualala River, CA.

ECOLOGICAL MANAGEMENT DECISION SUPPORT

The EMDS model showed that canopy density was fully, moderately and somewhat suitable on all the streams surveyed (Table 31). Embeddedness was somewhat to moderately unsuitable on Marshall, McKenzie and Carson. The South Fork was moderately suitable. Pool depths were undetermined or fully unsuitable in all four. Pool shelter was undetermined or fully unsuitable on all four. Overall pool quality ranged from undetermined to moderately and fully unsuitable. Data collected on tributaries less than one mile in length were not included.

Table 31: Ecological Management Decision Support (EMDS) Reach Model Scores on salmonid heath and productivity suitability for the Gualala Basin, CA, based upon habitat inventory surveys conducted in 1999 and 2001.

+++ =Fully Suitable; ++ = Moderately Suitable; + = Somewhat Suitable; U= Undetermined- = Somewhat Unsuitable; - - = Moderately Unsuitable; --- =Fully Unsuitable

Subbasin Stream **Scores**	**Canopy Cover Score**	**Embeddedness Score**	**Pool Depth Score**	**Pool Shelter Score**	**Pool Quality**	**2001MWAT Water Temp% Score**
Main Stem /South Fork	+	+	-	---	--	
Camper Creek (1999)	++	--	---	--	-	
Carson Creek (1999)	+++	--	-	---	--	
Marshall Creek	--	+	-	---	--	
McKenzie Creek (1999)	+	-	-	--	-	+
Palmer Canyon Creek	++	+	---	---	---	
Upper South Fork	+++	++	---	---	---	+++
Wild Hog Creek (1999)	+	-	---	---	---	

LIMITING FACTORS ANALYSIS

The lack of pool shelter/cover was the predominant limiting factor in the Mainstem/South Fork Subbasin, followed by pool depth, and canopy cover (Table 32).

Table 32: Limiting factors affecting salmonid health and production based upon habitat inventory surveys conducted in 1999 and 2001 and EMDS scores in the Gualala Basin, CA.

Rank 1 is the greatest limiting factor.

Subbasin Stream **Score**	Canopy Cover Related to Water Temperature	Embeddedness Related to Spawning Suitability	Pool Depth Related to Summer Conditions	Pool Shelter Related to Escape and Cover
Main stem/ South Fork				
Camper Creek (1999)			**1**	**2**
Carson Creek (1999)		**3**	**2**	**1**
Marshall Creek (partial survey)	**2**	**4**	**3**	**1**
McKenzie Creek (1999)	**3**	**4**	**2**	**1**
Palmer Canyon Creek		**3**	**2**	**1**
Upper South Fork		**3**	**2**	**1**
Wild Hog Creek (1999)	**3**	**4**	**2**	**1**

POTENTIAL REFUGIA

Refugia was not identified in the Mainstem/South Fork Subbasin (Table 27). Scores are based upon professional judgment, local expertise, habitat inventory surveys conducted in 1999 and 2001 and Ecological Management Decision Support scores.

Table 33: Refugia Categories for Surveyed Tributaries in the Main Stem/South Fork Subbasin Gualala River, CA.

Subbasin	Stream	Refugia Categories:				Other Categories:		
		High Quality	High Potential	Medium Potential	Low Quality	Non-Anadromous	Critical Contributing Area	Data Limited
Mainstem/South Fork	Camper Creek				X		X	
	Carson Creek				X			
	Upper South Fork				X		X	X
	Marshall Creek				X		X	
	McKenzie Creek				X		X	
	Palmer Canyon Creek				X			X
	Wild Hog Canyon Creek				X			

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ATTACHMENT A: DATA INVENTORY

GUALALA RIVER DATA INVENTORY

SUBBASIN	STREAM SURVEY	HABITAT TYPING	STREAM Lnth (mi.)	Survey Lnth (mi.)	Stream Order	COHO ND= Not detected	Source EFISHING	STEELHEAD P=Presence	Source EFISHING	OTHER FISH DATA
NORTH FORK	*Total miles surveyed 20.3 Percentage of blue line streams completed 81%*									
Bear Creek			2		1					
Billings Creek			4.9		2					
Doty Creek		2001	2.7	1.2	1	P79;P02	Cherr	P86-95	Jones; Harris	
Dry Creek		2001	3.2	2.1	1	P02		P86; P94	Jones	
North Fork	1964	2001	13.3	11.3	3			P86-01	Jones; Harris	
Hayfield Creek			1.1		1					
Little North Fork	1964	2001	4.1	3.9	2	P88;P91;P98;P02	Jones;GRI	P83-01	Jones	Coho planted 95, 96, &97.
Log Cabin Creek	1964	2001	1.1	0.3	1					
Lost Creek			0.3		1					
McGann Gulch		2001	2.1	0.4	1					
Robinson Creek	1980		1		1	P98	GRI	P83-86		
Stewart Creek		2001	2.3	1.5	1					
ROCKPILE	*Total miles Surveyed 8.5 miles Percentage of blue line streams completed 39%*									
Big Pepperwood	1964				1					
Groshong Creek			2.9		1					
Horsethief Cyn Ck			1.6		1					
Little Pepperwood					1					
Rockpile	1964	2001	21.8	8.5	2			P64	Parker	100/100 ft
Burnt Ridge Creek			1.1		1					
BUCKEYE	*Percentage of blue line streams completed 37%*									
Buckeye	1964;1970	2001	18.9	10.2	3					
Flat Ridge Creek	1964		0.9		1					
Franchini Creek			4.6		1	P79; ND01	Cherr; Harris			
Grasshopper Ck			2.1		2					
Little Creek			5.2		2					
NF Buckeye Creek	1964;1982		7		2	P64; Obs only				
Osser Creek	1964		6		1			P64		
Porter Creek	1964		3.8		1					
Roy Creek	1964		1		1					
Soda Springs Ck			1		2					
WHEATFIELD	*Total miles surveyed 34.0 miles Percentage of blue line streams completed 62%*									
Allen Creek			1		1					
Boyd Creek	1964;1970;1971		2.4		1			P95;P96	Daughtery	
Buzzard Crrek			3.2		1					
Elk Creek			1.2		1					
Elkhead Creek					1					
Fuller Creek	1964; 1970	1995	3.4	3.7	3	P79; P86;ND89	Cherr; Cox; Cox	P95;P96	Cox:Daughtery	
Grasshopper Ck					1					
Haupt Ck	1968;1964; 1970	2001	5.8	0.5	2	P64;P79; P86; ND01	Pool;Cherr; Cox;Harris	P96;P96	Daughtery	
NF Fuller Creek	1964;1971	1995	2	2.7	2	P64obs		P95;P96	Daughtery	
Redwood Creek			1.5		1					
SF Fuller Creek	1964;1970	1995	5.1	4.3	2	P70;ND89; ND95	Parke; Cox;Cox			
Soda Springs Ck			0.5		1					
Sullivan Ck		1995	1	1.0	1			P96snkl	Daughtery	
Tobacco Creek					1			P95;P96	Daughtery	
Wheatfield Fork	1964	2001	35.9	22.1	4	P79; P86;ND01	Cherr; Cox; LeDoux			
Wolf Creek			4.5		2					
Walter's Ridge	*Total miles surveyed 7.1 miles Percentage of blue line streams completed 32%*									
Cedar Creek	1964		2.9		1			P1		
Tombs Creek	1964	2001	6	7.1	2	ND01	LeDoux	P64obs;P81obs;P01		
Hedgepeth Lake	*Total miles surveyed 16.1 miles Percentage of blue line streams completed 42%*									
Britain Creek	1964		2.7		1			P64obs		
Danfield Creek	1964	2001	4.3	2.3	1			P64obs		
House Creek	1964	2001	13.6	10.4	3	P65;P79; P86; ND01	Cherr; Cox;LeDoux			
Jim Creek	1964				1			P64obs		
Patchett Ck	1964				1					
Pepperwood Creek		2001	4.6	3.4	2	P79;P86;ND01	Cherr; Cox; LeDoux			
Spanish Creek			4.4		1	P79;P86	Cherr; Cox			
Sugarloaf Creek	1964				1			P64obs		
SOUTHFORK/MS	*Total miles surveyed 25.1 Percentage of blue line streams completed 31%*									
Camper Ck		1999		0.7	1					
Carson Ck		1999	2.3	1.3	2			P99	Carr	
Lower SF	1964;1977				3					
Upper SF	1964	2001		1.6	2	ND01	LeDoux			
Main Stem					4			P52	Kimsey	
Marshall Creek	1964	v99 Up01	7.5	1.6	3	P64obs				
McKenzie Creek	1964	1999	4.1	2.6	2	P79	Cherr	P99	Albin	
Palmer Cyn Ck	1981	2001	1.4	0.1	1					
Sproule Creek					2					
Turner Cyn Ck					1	P86	Cox			
Wld Cattle Cyn Ck			1.5		2					
Wld HogCyn Ck		1999		0.5	1					
Estuary										
1980							Cox			Gill Nets
1984-1986										Bag Seine

ATTACHMENT B: COHO SALMON LIFE CYCLE

The following life history was taken from the Department of Fish and Game's Status Review of California Coho Salmon North of San Francisco, April 2002.

Adult coho salmon in general enter fresh water to spawn from September through January. In the smaller coastal streams of California, migration usually takes place between mid-November and mid-January (Baker and Reynolds 1986). Coho salmon move upstream after heavy fall or winter rains have opened the sand bars that form at the mouths of many California coastal streams, fish may enter streams without closures and larger rivers earlier. Arrival in the upper reaches of these streams generally peaks in November and December. Neave (1943), Brett and MacKinnon (1954) and Ellis (1962) indicate that coho salmon tend to move upstream primarily during daylight hours. They also state that they move by diurnal timing varied by stream and/or flow, but the majority move between sunrise and sunset.

Generally, coho salmon are able to utilize smaller streams than do Chinook salmon. In California, spawning mainly occurs from November to January although it can extend into February and March if drought conditions are present (Shapovalov and Taft 1954). Shapovalov and Taft (1954) note that the females choose the spawning sites near the head of a riffle, just below a pool, where the water changes form a laminar to a turbulent flow and where there is medium to small gravel substrate. The flow characteristics of the redd location are to ensure good aeration of eggs and embryos, and the flushing of waste products. The female digs a nest (redd) by turning on her side and using powerful rapid movements of the tail to dislodge the gravels. These gravels are transported a short distance downstream by the current. Repeating this action creates an oval to round depression at least as long as the fish. Eggs and sperm (milt) are released into the gravel, where, due to the hydrodynamics of the redd, they tend to remain until they are buried. It could be assumed that 720-2,850 eggs are deposited in each redd, according to an average of two redds per female (Gallagher 2002). The fertilized eggs are buried by the female by continuing to excavate upstream. Coho salmon redd sizes range from 0.69 to 16.37m^2 with an average redd size of 5.25m^2 (Gallagher 2002).

There is a positive correlation between fecundity of female coho salmon and body size. There is a definite tendency for fecundity to increase from California to Alaska (Sandercock 1991). Average coho salmon fecundities, as determined by various researchers working on British Columbia, Washington, and Oregon streams, range from 1,983 to 2,699 eggs and average 2,394 eggs per female (Sandercock 1991). Scott and Crossman (1973) find that fecundity of coho salmon in Washington streams ranged from 1,440 to 5,700 eggs for females that were 44 to 72 cm in length.

In California, eggs incubate in the gravels from November through April. The incubation period is inversely related to water temperature. The embryos hatch after eight to twelve weeks. California coho salmon eggs hatch in about 48 days at 48°F, and 38 days at 51.3°F (Shapovalov and Taft 1954). After hatching, the alevins (hatchlings) are translucent in color (Shapovalov and Taft 1954, Laufle et al. 1986, Sandercock 1991). This is the coho salmon's most vulnerable life stage when they are susceptible to siltation, freezing, dislodging due to gravel scouring and shifting, desiccation, and predation (Sandercock 1991, Knutson and Naef 1997, PFMC 1999). The alevin remain in the interstices of the gravel for two to ten weeks until their yolk sac has absorbed (becoming pre-emergent fry). At this time, their color changes to that more characteristic of fry (Shapovalov and Taft 1954, Laufle et al. 1986, Sandercock 1991). These color characteristics are silver to golden with large vertically oval marks (parr marks) along the lateral line that are narrower than the spaces between them.

The fry emerge from the gravel between March and July. The peak emergence occurs from March to May, depending on when the eggs were fertilized and the water temperature during development (Shapovalov and Taft 1954). The fry seek out shallow water, usually moving to the stream margins, where they form schools. As the fish feed heavily and grow, the schools generally break up and the juveniles (parr) set up territories. The parr continue to grow and expand their territories. They move progressively into deeper water, until July and August when they are in the deepest pools (CDFG 1994a). This is the period of maximum water temperatures, when growth slows (Shapovalov and Taft 1954). Food consumption and growth rate also decrease during the months of highest flows and coldest temperatures (December to February). By March, following the period of peak flows, they again begin to feed heavily and grow rapidly. Rearing areas generally used by juvenile coho salmon are low gradient coastal streams, wetlands, lakes, sloughs, side channels, estuaries, low gradient tributaries to large rivers, beaver ponds and large slack waters (PFMC 1999). The more productive juvenile habitats are found in smaller streams with low-gradient alluvial channels containing abundant pools formed by large woody debris (LWD). Adequate winter rearing habitat is important to successful completion of coho salmon life history.

After one year in fresh water, coho generally undergo smoltification. Smoltification is the physiological change adapting young anadromous salmonids for survival in saltwater (CDFG unpubl. data). The smolts begin migrating downstream to the ocean in late-March or early April. In some years, emigration can begin prior to March (CDFG unpubl. data) and can persist into July (Shapovalov and Taft 1954, Sandercock 1991). Weitkamp et al. (1995) indicates that peak downstream migration in California generally occurs from April to late May/early June. Factors that affect the onset of emigration include the size of the fish, flow conditions, water temperature, dissolved oxygen (DO) levels, day length, and the availability of food. In Prairie Creek, Bell (2001) indicates there is a small percentage of coho salmon that remain more than one year before going to the ocean. Low nutrient levels and or cold water temperatures, can contribute to slow growth, potentially causing coho salmon to reside for more than one year in fresh water (PFMC 1999). There may be other factors that contribute to a freshwater residency of longer than one year. Bell (2001) suggests that these fish may be the products of late spawners and are too young at the usual time of year when smoltification occurs. The amount of time coho salmon spend in estuarine environments is variable. PFMC (1999) indicates the time spent is less in the southern portion of their range. Upon ocean entry, the immature salmon remain in inshore waters, collecting in schools as they move north along the continental shelf (Shapovalov and Taft 1954; Anderson 1995). During their first summer at sea, coho in the Pacific north-west reside in nearshore waters and do not appear to migrate far from their point of entry to the sea (Pearcy and Fisher, 1988). Most remain in the ocean for two years, however, some return to spawn after the first year, and these are referred to as grilse or jacks (Laufle et al. 1986). Data on where the California coho salmon move to in the ocean are sparse, but it is believed they scatter and join schools of coho salmon from Oregon and possibly Washington (Anderson 1995).

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ATTACHMENT C: STEELHEAD TROUT LIFE CYCLE

Steelhead trout are an anadromous strain of rainbow trout. In contrast to all Pacific salmon, steelhead trout don't necessarily die after spawning. In the Gualala River, upstream migration occurs from November through April with the peak run occurring January through March. Gualala River steelhead trout spawners are typically age three years and older and weigh 3 to 16 pounds. Female trout carry an average of 3,500 eggs, with a range of 1,500-4,500. Like other salmonids, trout prefer to spawn in clean, loose gravel and swift, shallow water. Females choose the spawning sites near the head of a riffle, just below a pool, where the water changes from a laminar to a turbulent flow The female then digs a nest (redd) by turning on her side and using powerful rapid movements of the tail to dislodge the gravels. These gravels are transported a short distance downstream by the current. Repeating this action creates an oval to round depression at least as long as the fish. Eggs and sperm (milt) are released into the gravel, where, due to the hydrodynamics of the redd, they tend to remain until they are buried. Averages of 550-1,300 eggs are deposited in each redd. Steelhead trout redd sizes range from 0.3 to 6.66m^2 with an average redd size of 1.51m^2 (Gallagher 2002). Water flowing through the gravel supplies oxygen to the developing embryos. Egg survival is highly dependent upon the flow of well-oxygenated water. Studies have shown that there is a positive correlation between steelhead trout egg and embryo survival and water flow rate through the gravel. Gravel particle sizes selected by steelhead trout vary from about 0.25-3.0 inches in diameter (Flosi et al. 1998). The preferred temperatures for trout juveniles are between 50°F and 58°F, although they will tolerate temperatures as low as 45°F. Studies show that the upper preferred temperature limit for rainbow trout in Sierra Nevada streams is 65°F. The temperature range for spawning is somewhat lower, ranging from 39-55°F and the preferred incubation and hatching temperature is 50°F. During the egg's "tender" stage, which may last for the first half of the incubation period, a sudden change in water temperature may result in excessive mortality. Egg incubation in the Gualala River system takes place from December through May. The rate of embryo development is a function of temperature with higher temperatures contributing to faster development. At 50F, hatching occurs in 31 days; at 55°F, hatching occurs in 24 days (Flosi et al. 1998).

Newly hatched sac fry remain in the gravel until the yolk sac is completely absorbed, a period of 4-8 weeks. Emergence is followed by a period of active feeding and accelerated growth. The diet of newly emergent fry consists primarily of small insects and invertebrate drift. As they grow, fry move from the shallow quiet margins of streams to deeper and faster water. Juvenile steelhead trout usually remain in fresh water for two years. Adequate flow and temperatures are important to the juvenile populations at all times since rearing steelhead trout are present in fresh water throughout the year. Steelhead trout surviving to adulthood generally spend at least two years in fresh water before migrating downstream and out to sea. The migration downstream is largely composed of 2-year old smolts. This takes place during spring and early summer. Emigration appears to be more closely associated with size than age, 6-8 inches being the size of most downstream migrants. Late spring rains are important to this migration, particularly in streams that have seasonal closures at the mouth. These rains open or reopen the coastal lagoon to the ocean allowing the smolts to leave the river.

Bluebacks or Spring Run Steelhead Trout are a smaller strain weighing about 3-5 lbs. found on the Gualala River. Bluebacks enter freshwater in February and spawn through May (J. Richardson pers comm.) (Boydstun 1976). Anglers comment that they "put up a great fight". Bluebacks probably make smaller redds, lay smaller eggs, and are probably able to utilize smaller-sized spawning substrate. Blueback is a regional term used to describe particular fishes or distinct runs. In the case of the Gualala River, the term refers to a smaller seemingly distinct strain of fish that only enters the river in the late winter and spring.

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ATTACHMENT D: FACTORS LIMITING SALMONID POPULATIONS

Introduction

The main objective of the North Coast Watershed Assessment Program (NCWAP) and a task delegated to the Department of Fish and Game (CDFG) was to identify factors that limit production of anadromous salmonid populations in North Coast watersheds. A loosely termed approach to identify these factors is often called a "limiting factors analysis" (LFA). The limiting factors concept is based upon the assumption that eventually every population must be limited by the availability of resources (Hilborn and Walters 1992) or that a population's potential may be constrained by an over abundance, deficiency, or absence of a watershed ecosystem component. Identifying stream habitat factors that limit or constrain anadromous salmonids is an important step towards setting priorities for habitat improvement projects and management strategies. These strategies are aimed at the recovery of declining fish stocks and the protection of viable fish populations.

Although several factors have contributed to the decline of anadromous salmonid populations, habitat loss and modification are major determinants of their current status (FEMAT 1993). Our approach to a LFA integrates two habitat-based methods. These methods are aimed at evaluating the status of key aspects of stream habitat that affect anadromous salmonid production. The first method uses priority ranking habitat categories. These are based on a CDFG team assessment of data collected during stream habitat inventories. The second method uses a computer-based decision support system, Ecosystem Management Decision Support (EMDS). This system evaluates the suitability of key stream habitat components to support anadromous fish populations. These habitat-based methods assume that stream habitat quality and quantity play important roles in a watershed's ability to produce viable salmonid populations. The LFA assumes that poor habitat quality and reduced quantities of favorable habitat impairs fish production. The NCWAP LFA is focused mainly on those physical habitat factors within freshwater and estuarine ecosystems that affect spawning and subsequent juvenile life history requirements during low flow seasons.

Two general categories of factors or mechanisms limit salmonid populations: 1) density independent; and 2) density dependent mechanisms. Density independent mechanisms generally operate without regard to population density. These include factors related to habitat quality such as stream flow and water temperature. For example, when water temperatures exceed lethal levels fish will die regardless of the population density. Density dependant mechanisms operate according to population density and habitat carrying capacity. Competition for food, space, and shelter are examples of density dependant factors that affect growth and survival. These occur when populations reach or exceed the habitat carrying capacity. The NCWAP's approach considers these two types of habitat factors before prioritizing recommendations for habitat management strategies. Priority steps are given to preserving and increasing the amount of high quality (density independent) habitat in a cost effective manner.

Methods

The LFA starts by identifying environmental factors that affect anadromous salmonid spawning success: egg incubation, fry emergence, juvenile rearing, and movements though the stream network. Stream surveys are conducted to quantify stream habitat factors or characteristics such as pool depth, shade canopy, and spawning substrate embeddedness. Data characterizing stream habitat conditions are collected according to protocols described in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al 1998).

Table 34: Fish habitat components and parameters potentially applicable for limiting factors analysis.

Water Quality

- Temperature
- Flow
- Turbidity

Sediments

- Pool tail embeddedness
- Spawning gravel composition, permeability, and stability
- Bank stability

Riparian Vegetation

- Percent shade canopy cover by habitat type and average percent by reach, stream, or watershed
- Species diversity (% coniferous vs. deciduous)
- Seral stage
- Large Woody Debris future recruitment
- Sediment filter
- Bank stability

Large Wood

- Abundance, size, and distribution of in channel Large Woody Debris (LWD)
- Future recruitment of LWD into stream

Pool and Riffle Habitat Characteristics

- Maximum pool depth
- Residual pool depth and volume
- Pool, run and riffle frequency
- Pool, run and riffle percent of total length of stream
- Pool shelter complexity Value
- Coverage (% of habitat coverage)
- Pool shelter rating (shelter value X % cover)

Physical Stream Characteristics

- Barriers or impediments to upstream and downstream fish movements
- Stream gradient as a barrier to upstream migration
- Stream crossings
- Debris jams
- Excessive sediment deposition attenuating stream flows or creating dry channels
- Channel connectivity

Priority rankings of habitat categories are based on a CDFG team assessment of data collected during stream habitat inventories. These inventories are a combination of several stream reach surveys: habitat typing, channel typing, biological assessments, and in some reaches LWD/riparian zone recruitment assessments. A fisheries biologist and/or habitat specialist conducts QA/QC on field crews and collected data. Then data analysis is performed and determinations on general areas of habitat deficiencies are made. Finally, recommendation categories for potential habitat improvement activities are selected and ranked.

Ecological Management Decision Support (EMDS) is used to evaluate the suitability of key stream habitat components. These components are assumed to support anadromous fish populations. The EMDS analyses is based on a set of reference conditions determined from empirical studies of naturally functioning channels, expert opinion, and peer reviewed literature. For each factor, the NCWAP team will create a conceptual model that relates, compares, and measures habitat data collected at the reach scale during stream surveys. This model compares parameter values to relative habitat quality or potential suitability for fish. Using these "habitat quality functions" and the EMDS, the various parameters will be combined into an indicator of fish habitat status. The EMDS rates each habitat component with a suitability score between -1 and +1. A score of +1 means high suitability and – 1 means low or inadequate suitability.

Scores between -1 and +1 indicate a degree of suitability between high and low. Positive scores indicate suitable conditions and negative scores indicate less than suitable conditions. If a habitat component's score does not fit within the suitable range of the reference values, it may be considered a limiting factor. For evaluation at the reach, stream, subbasin, and basin scale, EMDS scores are weighted according to each stream reach length. Scores from long reaches carry more weight than those from short reaches. The equation for calculating stream reach weighted average for identifying stream, subbasin and basin scale limiting factors is:Weighted Average by Stream Reach =

$\frac{\sum L_i S_i}{\sum L_i}$ Where: L_i = reach length and S_i = EMDS score by reach

Habitat components evaluated by the EMDS that receive the lowest overall rating score will be considered as limiting factors. Limiting factors identified by the EMDS will be used to support or refine the broader scoped interpretations derived from CDFG and interdisciplinary watershed synthesis teams assessments. Detailed discussions of analysis using the EMDS and the development of reference curves are provided in Appendix A.

Results from the two LFA methods are displayed in tabular form and then evaluated by CDFG biologists and interdisciplinary watershed synthesis teams. Limiting factors identified by the EMDS will be used to support or refine the broader scoped interpretations derived from CDFG and interdisciplinary watershed synthesis teams assessments. A third list of limiting factors may be generated at the watershed scale for making recommendations for restoration projects or management strategies to improve or maintain stream habitat conditions.

EMDS evaluations from the "watershed condition" knowledge base help identify relationships or associations between watershed processes or land use that contribute to a limiting factor's root cause (see Appendix 1). This includes evaluations of road density, riparian condition, upland condition and others. The results generated by the EMDS system are synthesized and integrated with other watershed information collected by the NCWAP team. Finally, the team addresses the factors or issues that may impair fish populations and makes recommendations for improving watershed conditions to benefit salmonid fishery resources

The CDFG acknowledges that this procedural LFA is a simplified approach to identifying ecosystem components that constrain habitat capacity, fish production, and species life history diversity (Mobrand et al. 1997). Therefore, the LFA is developed for assessing coarse scale stream habitat components and may not satisfy the need for site-specific analysis at an individual landowner scale. It is important to understand that LFA tributary survey components and recommendations for habitat improvements are made from stream reach conditions that are observed at the times of the surveys and do not include upslope watershed observations other than those that can be seen from the streambed. In addition, we lack specific habitat surveys for juvenile winter habitat, so we are unable to perform focused winter habitat assessments. Stream surveys reflect a single time and do not anticipate future conditions. However, these general recommendation categories have proven to be useful as the basis for specific project development, and provide focus for on-the-ground project design and implementation. Bear in mind that stream and watershed conditions change over time and periodic survey updates and field verification are necessary if projects are being considered.

In general, the recommendations that involve erosion and sediment reduction by treating roads, failing stream banks, and riparian corridor improvements precede the instream recommendations in reaches that demonstrate disturbance levels associated with watersheds in current stress. Instream improvement recommendations are usually a high priority in streams that reflect watersheds in recovery or good health. Project recommendations can be made in concurrence if conditions warrant.

Fish passage problems, especially in situations where favorable stream reaches are blocked by a man-caused feature (e.g., culvert), are usually a treatment priority. Additional considerations enter into the decision process before general recommendations are further developed into improvement activities. In these regards, NCWAP's more general watershed scale upslope assessments can go a long way in helping determine the suitability of conducting instream improvements based upon watershed health. As such, there is an important relationship between the instream and upslope assessments.

In addition to watershed condition considerations as a context for these recommendations, there are certain logistic considerations that enter into a recommendation's subsequent ranking for project development. These can include work party access limitations based upon lack of private party trespass permission and/or physically difficult or impossible locations of the candidate work sites. Biological considerations are made based upon the propensity for benefit to multiple or single fishery stocks or species. Cost benefit and project feasibility are also factors in project selection for design and development.

ATTACHMENT E: TEN POOL PROTOCOL

California Department of Fish and Game
Northern California - North Coast Region

Modified Ten Pool Protocol
For Use During
Calendar Year 2001 Coho Salmon
Presence/Absence Surveys

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INTRODUCTION

In response to the petition to the California Fish and Game Commission to list coho salmon as an endangered species, pursuant to the California Endangered Species Act (CESA), personnel of the California Department of Fish and Game=s (CDFG) Northern California - North Coast Region (NC-NCR) will determine coho salmon presence/absence in a portion of their range in Northern California (Winchuck River system south to the Mattole River system). The objective of this survey is to document coho salmon presence/absence in 396 locations identified in Brown and Moyle=s 1994 coho salmon status review in Humboldt, Del Norte, Trinity, Siskiyou, Mendocino and Glenn Counties. This documentation will provide a basis for comparison of the status of coho salmon (in terms of percent presence/absence) reported by Brown and Moyle (1994) with the latest available information. Our approach has two phases: 1) file review, and 2) field survey using a modified version of a Ten Pool Protocol reported by Adams et al. (1966).

File Review.

CDFG personnel will collect all available current and historic files, which describe fish sampling efforts and findings for each of the 396 locations in the project area. The Department of Fish and Game file records will be augmented with data obtained from other sources, including but not limited to, the Forest Science Project (FSP), Humboldt State University, Simpson Timber Company, PALCO and other Scientific Collectors. All documents will be reviewed for date, location, and coho salmon presence. If coho salmon were present, we would attempt to determine their brood year. The result of this effort will be to generate a coho salmon brood year lineage for each stream. Streams with documented coho salmon presence of three consecutive brood years during the period of 1994 through 2000 will not be surveyed in 2001. Streams with missing brood year information will be sampled by any means. If a missing brood year is not established by simpler means, then the ten pool protocol will be employed.

Field Survey

For streams where coho salmon presence/absence data is lacking, or there is no recent survey indicating the presence of coho salmon, the modified ten-pool protocol (described below) will be employed.
Sampling reaches (LOWER MIDDLE, UPPER) will be predetermined before entering the field using the best available data, including, but not limited to previous habitat and biological surveys, stream gradient, channel type, channel entrenchment, topography, size, location of tributary streams and private lands access agreements. Geographic Information Systems (GIS) will be used to divide the anadromous section of each stream into gradients of 0 to 5%, >5 to <10%, and >10%. Stream segments with 0-5% gradient will be given a higher priority for sampling effort. For the purpose of this year=s survey, the end of coho anadromy is defined as 0.5 kilometer (0.3 miles) with $\geq$10% slope and the absence of perennial stream segments with $\leq$ 5% gradient further upstream.

Snorkel surveys (direct observation) will be the primary sampling technique employed. If project personnel encounter situations where physical habitat features render snorkel surveys ineffective (e.g., high turbidity, deep pools) or if human health hazards (e.g., dairy waste or unknown waste discharges) are present, then alternate sample methods should be employed. Minimum crew sizes for each sampling method are as follows: snorkel survey (2 people); backpack electrofishing (minimum of two people per electrofisher); seining (3 people); and baited minnow trapping (2 people). Snorkeling, electrofishing (a second backpack shocker may be used if the stream is wider than 10 feet) and seining effort will be limited to one pass. Baited minnow trapping effort should be confined to one set (30 minute soak) of at least two traps per pool.

MODIFIED TEN POOL PROTOCOL

A minimum of three reaches will be surveyed in the following sequence: LOWER - MIDDLE - UPPER. Ten pools or flatwater habitat units (hereafter referred to as pools) will be surveyed in any given reach; these ten pools constitute a Survey Section. Field crews will have the latitude to select pools based on shade, velocity and instream habitat complexity; however, crews may not skip more than five pools in any given Survey Section.

The pool survey for the lowermost reach will commence where the stream has defined banks and its habitat features are defined by its stream power. This protocol excludes stream segments flowing through aggraded deltas or other areas influenced by high flow of the water to which it is tributary.

Habitats will be sampled as defined by the Level II category for stream habitat typing (riffle, pool, flatwater). The primary Level II habitat types surveyed will be pools; however, if pool habitat is lacking, flatwater habitats (glides, pocket water, run, and step-run) will be sampled. Target streams will be surveyed according to the following decision sequence:

If coho salmon are present, (presence is defined as one coho salmon) in the LOWER Reach Survey Section, then it is not necessary to examine the MIDDLE or UPPER Reaches. Complete all ten pools in the LOWER Reach Survey Section before moving onto the next stream assignment list and repeat this decision sequence.

If coho salmon are not observed in the LOWER Reach Survey Section, then move up to the MIDDLE Reach Survey Section. If coho salmon are observed in the MIDDLE Reach Survey Section, then it is not necessary to examine the UPPER Reach Survey Section. Move on to the LOWER Reach Survey Section of the next stream on your assignment list and repeat this decision sequence.

If coho salmon are not observed in the MIDDLE Reach Survey Section, then move up to the UPPER Reach Survey Section. Examine 10 pools and record your findings. Move on to the LOWER Reach Survey Section of the next stream on your assignment list and repeat this decision sequence.

Each surveyed reach shall be flagged at the downstream end and labeled with the following:

- DATE (dd/mm/yyyy)
- CDFGCI (acronym for Department of Fish and Game Coho Investigation)
- Stream Reach designation (LOWER, MIDDLE, or UPPER)

Flagging will not be hung within State, National or City Parks, urban areas or anywhere it would be considered a visual nuisance by property owners. These areas are generally high traffic areas, within city limits or close to roads.

The upper and lower boundary of each survey section will be geo-referenced, using GPS, as a waypoint for later downloading into GIS. A Waypoint is entered as a combination of numbers and letters using the unique (Brown and Moyle) designated stream number, followed by a hyphen and A for lower, B for middle or C for the upper survey area. The numerals 1 and 2 are used to define the lower or upper survey area boundary, respectively. For example, the waypoint for the boundary of the lowermost reach of Howe Creek, Eel River is 252-A1. Conversely, the end of the uppermost sample segment of Howe Creek is 252-C2.

The defaults settings for the standard issue GPS 12XL will be the following: Position Format = decimal degrees (hddd.dddd°); Navigation Setup: Map Datum = NAD 27 CONUS,

CDI = ±0.25, Angle = Degrees, Units = Statute, Heading = E016; System Setup, Offset -7.00, Hours =24. GPS units will be checked prior to each day's field surveys for the above settings due to the possibility of the units resetting to factory defaults when the batteries run low.

Snorkel surveyors will travel through each Survey Section in an upstream direction. Enter each pool at the downstream end, in a manner, which will minimize fish disturbance, and move upstream. Record fish and other vertebrate species observed; assign an abundance category (e.g., 0 = no fish, 1 = 1 fish; 2 = 2-5 fish; 3 = > 5 fish) for each fish species present. Salmon (e.g., chinook and coho) will be identified by species. Steelhead trout and coastal cutthroat trout are difficult to identify at a small size, so lump them together and record your abundance rating in the ATrout@ column on the data card. Separate coastal cutthroat trout from steelhead trout only if you can make a positive identification.

If a crew encounters a section where stream gradient exceeds 10%, which was not modeled by GIS, or any other barriers, the crew will determine if continuing the survey is warranted. If coho salmon passage is not possible, then survey the ten pools immediately downstream of the barrier and fully document the decision-making process through narrative and photographs. The base of the barrier should be recorded in the field notes and entered in the GPS as a waypoint. If coho salmon passage is possible, then proceed to the next reach assignment, but note and photograph this area for future reference.

While conducting your survey, it may be necessary to check a pool a second time because one or both members are not confident in their results. In this case, wait at least 20 minutes to let the fish settle down and for the pool to clear, then repeat the dive. If the team members agree that confidence is again low, flag the pool and enter its coordinates as a waypoint in the GPS, and move upstream to the next pool. Be sure not to count the problem pool as part of the ten pools. If the confidence level is high, then only record results of the second dive. In either case, clearly describe your decision-making process on the data sheet.

Record the description of each surveyed pool to Level IV Habitat Type category, if possible. Visually estimate average wetted width, average length, and maximum depth for all surveyed pools. In the case of a skipped pool (see preceding paragraph), identify its Level IV designation and visually estimate the dimensions of the pool.

Photographs: Take at least one photograph of each pool surveyed. The photograph(s) should frame the entire pool and all its significant features. Photographs should include a placard (Mylar or plastic slate) with the stream name, location, reach, and pool number. The placard with the stream name should be located in the shade to keep the lettering from washing out in the picture. Photographs of fish barriers, water diversion, sources of pollution, and examples of excellent habitat conditions should also have a placard with stream name in view. Using a fine point Sharpe, label all used rolls of film and their canisters with the date, stream name and reach. Write the same information on a separate piece (two to three inches) of flagging and also place it inside the film canister. (Note: do not change film where a dropped roll could be lost. For example, do not sit on a rock in mid-stream and change rolls as a dropped roll of film can be swept away.)

If you use sampling methods that will give you Afish-in-hand@ (e.g., electrofishing, baited minnow trapping, etc., photograph at least one coho for documentation, when they are found.

At the end of each stream survey and before leaving the area, spend several minutes writing a narrative about special stream features, especially the reason for deviating from the established protocol. A journal will be included in each sample kit for this purpose.

Snorkel surveyors will have a minimum of eight dive hours in waters bearing coho salmon, chinook salmon and steelhead trout. Snorkel divers will be taught and practice standardized counting techniques, fish identification, and habitat type recognition. These training hours are to be supervised by a CDFG fisheries biologist or other trained and qualified equivalent individuals with at least three field seasons of snorkeling experience for juvenile salmonids. Records of training hours will be maintained. Snorkel surveyors will trout only be deployed in the field if they are capable of identifying coho salmon, chinook salmon and steelhead trout with no errors.

Backpack electrofishing crews will be lead by project-members who have had at least one field season of electrofishing experience. To become an electroshocking crew leader, a crew member must have at least 160 hours of supervised hands-on experience and the confidence of their lead and co-workers. This training will include familiarization with electrofisher set-up, setting controls, electrofishing techniques, fish anesthesia, fish identification and handling. Techniques to minimize the risk of fish injury and mortality will be stressed.

Each project-member will gain at least 4 hours of supervised hands-on training by an experienced CDFG fisheries biologist in the use of baited minnow traps and its application in fish surveys. This training will include identifying trap locations, trap rigging and baiting, deployment, trap recovery, fish removal and handling.

All divers will be given water safety training (including swift water rescue technician [or equivalent] training, first aid, CPR, and other tailgate safety briefings, as appropriate.

Quality Assurance/Quality Control

Up to 5% of all streams will be selected for a re-visit by a second snorkel survey team for the purpose of Quality Assurance/Quality Control (QA/QC). The dive team conducting the QA/QC will: i) not have access to the survey data to avoid bias, ii) will employ the one pass method, and iii) conduct the dive during the same work week the first dive occurred.

If the species list resulting from the QA/QC survey varies from the list of species observed in the first survey, the first team is placed under probation. Crew members under probation will be paired up with a biologist; probation will be lifted once the biologist=s confidence is regained.

Because photographs will record species composition, QA/QC will not be required for minnow trapping and electrofishing surveys.

Each data omission on the field form, without explanation, and changes of protocol without explanation constitute a QA/QC error. Five data entry irregularities per stream reach will constitute data QA/QC failure and will require data audits of the next five stream surveys.

LITERATURE CITED

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Brown, L.R., P.B. Moyle, and R.M. Yoshiyama. 1994. Historical Decline and Current Status of Coho Salmon in California. North American Journal of Fisheries Management 14:237-261.

Brownell, N.F., W.M. Kier, and M.L. Reber. 1999. Historical and Current Presence and Absence of Coho Salmon, *Oncorhynchus kisutch*, in the Northern California Portion of the Southern Oregon-Northern California Evolutionary Significant Unit. Report prepared for the U.S. National Marine Fisheries Service, Southwest Fisheries Science Center. Kier and Associates, Sausalito, California. 49

ATTACHMENT F: GUALALA RIVER – CONDENSED TRIBUTARY REPORTS

BUCKEYE CREEK

Buckeye Creek is a tributary to the South Fork Gualala River, a tributary to the Gualala River, tributary to the Pacific Ocean, located in Sonoma County, California. Buckeye Creek's legal description at the confluence with the South Fork Gualala River is T10N R14W S06. Its location is 38?44?24.9? north latitude and 123?27?22.1? west longitude. Buckeye Creek is a third order stream and has approximately 16 miles of blue line stream according to the USGS McGuire Ridge 7.5 minute quadrangle. Buckeye Creek drains a watershed of approximately 39.6 square miles. Elevations range from about 195 feet at the mouth of the creek to 1,500 feet in the headwater areas. Mixed hardwood and mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 1 to Gualala, then southeast on South Fork Gualala River Road to the mouth of Buckeye Creek.

A. Palacios and K. VandenBranden (Pacific States Marine Fisheries Commission) conducted the habitat inventory of August 23 to November 1, 2001. The total length of the stream surveyed was 51,085 feet with an additional 2,659 feet of side channel.

Buckeye Creek is an F4 channel type for 49,047 feet of the stream surveyed and an F1 channel type for 2,038 feet of the stream surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. F1 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and very stable with a bedrock controlled channel. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders, fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; poor for boulder clusters. The suitability of F1 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for single wing-deflectors and log cover; poor for plunge weirs, boulder clusters and opposing wing-deflectors.

Survey Data:

Location of Stream Mouth:

Survey Dates: 8/23/01 through 11/1/01

USGS Quad Map: Stewarts Point Latitude: 38º 44' 25" Longitude: 123º 27' 23"

Stream Reach: 1	
Channel Type: F4	Canopy Density: 71%
Bankfull Width: 54.2 ft	Coniferous Component: 38%
Channel Length: 20623 ft	Deciduous Component: 62%
Riffle/Flatwater Mean Width: 13 ft	Pools by Stream Length: 36%
Total Pool Mean Depth: 1.1 ft	Pools >= 3 ft Depth: 31%
Base Flow: 0.5 cfs	Mean Pool Shelter Rating: 51
Water Temperature: 48-64ºF	Dominant Shelter: Small Woody Debris
Air Temperature: 50-72ºF	Occurrence of Large Organic Debris: 13%
Dominant Bank Vegetation: Deciduous Trees	Dry Channel: 339
Vegetative Cover: 50%	
Dominant Bank Substrate: Cobble/Gravel	
Embeddedness Value: 1: 12% 2: 62% 3: 15% 4: 0% 5: 12%	

Stream Reach: 2	
Channel Type: F4	Canopy Density: 55%
Bankfull Width: 36 ft	Coniferous Component: 41%
Channel Length: 28475 ft	Deciduous Component: 59%
Riffle/Flatwater Mean Width: 13 ft	Pools by Stream Length: 52%
Total Pool Mean Depth: 1.4 ft	Pools >= 3 ft Depth: 24%
Base Flow: 0.5 cfs	Mean Pool Shelter Rating: 52

Water Temperature: 61-62ºF	Dominant Shelter: Boulders
Air Temperature: 58-76°F	Occurrence of Large Organic Debris: 8%
Dominant Bank Vegetation: Deciduous Trees	Dry Channel: 31 ft
Vegetative Cover: 66%	
Dominant Bank Substrate: Cobble/Gravel	
Embeddedness Value: 1: 14% 2: 67% 3: 11% 4: 0% 5: 8%	
Stream Reach: 3	
Channel Type: F1	Canopy Density: 43%
Bankfull Width: 23.5 ft	Coniferous Component: 26%
Channel Length: 2038 ft	Deciduous Component: 74%
Riffle/Flatwater Mean Width: 17 ft	Pools by Stream Length: 45%
Total Pool Mean Depth: 0.8 ft	Pools >= 3 ft Depth: 16%
Base Flow: 0.5 cfs	Mean Pool Shelter Rating: 40
Water Temperature: 56-60ºF	Dominant Shelter: Bedrock Ledges
Air Temperature: 60-64ºF	Occurrence of Large Organic Debris: 11%
Dominant Bank Vegetation: Deciduous Trees	Dry Channel: 0 ft
Vegetative Cover: 48%	
Dominant Bank Substrate: Cobble/Gravel	
Embeddedness Value: 1: 0% 2: 53% 3: 11% 4: 0% 5: 37%	

DANFIELD CREEK

Danfield Creek is a tributary to Pepperwood Creek, a tributary to House Creek, tributary to Wheatfield Fork, tributary to South Fork Gualala River, tributary to Gualala River, tributary to the Pacific Ocean, located in Mendocino County, California. Danfield Creek's legal description at the confluence with Pepperwood Creek is T09N R12W S09. Its location is 38?37?44? north latitude and 123?11?48? west longitude. Danfield Creek is a first order stream and has approximately 4.3 miles of blue line stream according to the USGS Tombs Creek 7.5 minute quadrangle. Danfield Creek drains a watershed of approximately 2.9 square miles. Elevations range from about 600 feet at the mouth of the creek to 1,490 feet in the headwater areas. Grass and oak forest dominates the watershed. The watershed is entirely privately owned and is managed for agriculture. Vehicle access exists via Highway 1 to Stewarts Point and east on Tin Barn Road.

S. Green and M. Coleman (Pacific States Marine Fisheries Commission) conducted the habitat inventory of October 17 - 19, 2001. The total length of the stream surveyed was 12,193 feet with an additional 388 feet of side channel.

Danfield Creek is an F4 channel type for the entire 12,193 feet of the stream surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. The suitability of F4 channel types for fish habitat improvements is as follows: good for bank-place boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; poor for boulder clusters.

Survey data:	
Location of Stream Mouth:	
Survey Dates: 10/17/01 through 10/19/01	
USGS Quad Map: Tombs Creek Latitude: 38º 37' 44"	Longitude: 123º 11' 48"
Stream Reach: 1	
Channel Type: F4	Canopy Density: 49%
Bankfull Width: ft	Coniferous Component: 0%
Channel Length: 12193 ft	Deciduous Component: 100%
Riffle/Flatwater Mean Width: 10 ft	Pools by Stream Length: 16%
Total Pool Mean Depth: 1.5 ft	Pools >= 3 ft Depth: 22%
Base Flow: 0.1 cfs	Mean Pool Shelter Rating: 26
Water Temperature: 53-68ºF	Dominant Shelter: Boulders
Air Temperature: 62-84ºF	Occurrence of Large Organic Debris: 4%
Dominant Bank Vegetation: Deciduous Trees	Dry Channel: 0 ft

Vegetative Cover: 49%
Dominant Bank Substrate: Silt/Clay/Sand
Embeddedness Value: 1: 2% 2: 24% 3: 61% 4: 2% 5: 10%

DOTY CREEK

Doty Creek is a tributary to the Little North Fork Gualala River, a tributary to the North Fork Gualala River, tributary to the Gualala River, tributary to the Pacific Ocean, located in Mendocino County, California. Doty Creek's legal description at the confluence with the Little North Fork Gualala River is T11N R15W S10. Its location is 38?49?15.6? north latitude and 123?31?55.4? west longitude. Doty Creek is a second order stream and has approximately 2.7 miles of blue line stream according to the USGS Gualala 7.5 minute quadrangle. Doty Creek drains a watershed of approximately 1.5 square miles. Elevations range from about 390 feet at the mouth of the creek to 2,000 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 1 to Iversen Point, east on Iversen Road to Signal Ridge Road.

S. Green and S. Doyle (Pacific States Marine Fisheries Commission) conducted the habitat inventory of July 11 - 19, 2001. The total length of the stream surveyed was 6,237 feet.

Doty Creek is an F4 channel type for the first 5,895 feet of the stream surveyed and an A3 for the remaining 342 feet surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders, fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; poor for boulder clusters. The suitability of A3 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, opposing wing-deflectors and log cover; poor for boulder clusters and single wing deflectors.

Survey Data:
Location of Stream Mouth:
Survey Dates: 7/11/01 through 7/19/01
USGS Quad Map: Gualala Latitude: 38º 49' 15" Longitude: 123º 31' 55"

Stream Reach: 1

Channel Type: F4	Canopy Density: 93%
Bankfull Width: 18 ft	Coniferous Component: 53%
Channel Length: 5895 ft	Deciduous Component: 47%
Riffle/Flatwater Mean Width: 7 ft	Pools by Stream Length: 20%
Total Pool Mean Depth: 0.6 ft	Pools >= 3 ft Depth: 8%
Base Flow: 1.1 cfs	Mean Pool Shelter Rating: 52
Water Temperature: 54-54ºF	Dominant Shelter: Large Woody Debris
Air Temperature: 58-58ºF	Occurrence of Large Organic Debris: 27%
Dominant Bank Vegetation: Coniferous Trees	Dry Channel: 1045 ft.

Vegetative Cover: 87%
Dominant Bank Substrate: Silt/Clay/Sand
Embeddedness Value: 1: 4% 2: 23% 3: 50% 4: 21% 5: 2%

Stream Reach: 2

Channel Type: A3	Canopy Density: 97%
Bankfull Width: 13 ft	Coniferous Component: 22%
Channel Length: 342 ft	Deciduous Component: 78%
Riffle/Flatwater Mean Width: 6 ft	Pools by Stream Length: 37%
Total Pool Mean Depth: 1.2 ft	Pools >= 3 ft Depth: 13%
Base Flow: 1.1 cfs	Mean Pool Shelter Rating: 20
Water Temperature: 54-54ºF	Dominant Shelter: Boulders
Air Temperature: 58-58ºF	Occurrence of Large Organic Debris: 26%
Dominant Bank Vegetation: Coniferous Trees	Dry Channel: 25 ft

Vegetative Cover: 66%
Dominant Bank Substrate: Silt/Clay/Sand
Embeddedness Value: 1: 14% 2: 14% 3: 29% 4: 14% 5: 29%

DRY CREEK

Dry Creek is a tributary to the North Fork Gualala River, tributary to the Gualala River, tributary to the Pacific Ocean located in Mendocino County, California. Dry Creek's legal description at the confluence with North Fork Gualala River is T11N R14W S07. Its location is 38?48?51? north latitude and 123?28?29? west longitude. Dry Creek is a first order stream and has approximately 0.9 miles of blue line stream according to the USGS McGuire Ridge 7.5 minute quadrangle. Dry Creek drains a watershed of approximately 5.3 square miles. Elevations range from about 195 feet at the mouth of the creek to 1,600 feet in the headwater areas. Mixed hardwood and mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via private roads located east of the town of Gualala.

S. Doyle and S. Green (Pacific States Marine Fisheries Commission) conducted the habitat inventory of August 15 - 21, 2001. The total length of the stream surveyed was 11,161 feet with an additional 817 feet of side channel.

Dry Creek is a B4 channel type for the first 8,431 feet of the stream surveyed, and an F4 channel type for the remaining 2,706 feet. B4 channel types are moderately entrenched, moderate gradient, riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks, and gravel channel. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. The suitability of F4 channel types for fish habitat improvements is as follows: good for bank-place boulders; fair for plunge weirs, single and opposing wing deflectors, channel constrictors and log cover; poor for boulder clusters. The suitability of B4 channel types for fish habitat improvement structures is as follows: excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors and log cover.

Survey Data:

Location of Stream Mouth:
Survey Dates: 8/3/01 through 8/22/01
USGS Quad Map: McGuire Ridge Latitude: 38º 48' 51" Longitude: 123º 28' 29"

Stream Reach: 1
Channel Type: B4
Bankfull Width: 24.5 ft
Channel Length: 8431 ft
Riffle/Flatwater Mean Width: 12 ft
Total Pool Mean Depth: 0.7 ft
Base Flow: 0.1 cfs
Water Temperature: 55-68ºF
Air Temperature: 57-84ºF
Dominant Bank Vegetation: Coniferous Trees
Vegetative Cover: 69%
Dominant Bank Substrate: Cobble/Gravel
Embeddedness Value: 1: 24% 2: 35% 3: 4% 4: 0% 5: 37%
Canopy Density: 59%
Coniferous Component: 41%
Deciduous Component: 59%
Pools by Stream Length: 23%
Pools >= 3 ft Depth: 6%
Mean Pool Shelter Rating: 27
Dominant Shelter: Boulders
Occurrence of Large Organic Debris: 9%
Dry Channel: 3828

Stream Reach: 2
Channel Type: F4
Bankfull Width: 9.5 ft
Channel Length: 2706 ft
Riffle/Flatwater Mean Width: 12 ft
Total Pool Mean Depth: 0.6 ft
Base Flow: 0.1 cfs
Water Temperature: 62-63ºF
Air Temperature: 60-73ºF
Dominant Bank Vegetation: Coniferous Trees
Canopy Density: 87%
Coniferous Component: 48%
Deciduous Component: 52%
Pools by Stream Length: 26%
Pools >= 3 ft Depth: 4%
Mean Pool Shelter Rating: 36
Dominant Shelter: Boulders
Occurrence of Large Organic Debris: 9%
Dry Channel: 152

Vegetative Cover: 46%
Dominant Bank Substrate: Cobble/Gravel
Embeddedness Value: 1: 67% 2: 22% 3: 8% 4: 0% 5: 4%

DRY CREEK TRIBUTARY #1

Unnamed Tributary #1 to Dry Creek is a tributary to Dry Creek, a tributary to the North Fork Gualala River, a tributary to the Gualala River, a tributary to the Pacific Ocean located in Mendocino County, California. Unnamed Tributary to Dry Creek's legal description at the confluence with Dry Creek is T11N R14W S06. Its location is 38?49?54? north latitude and 123?28?17? west longitude. Unnamed Tributary to Dry Creek is a first order stream and has approximately 2.9 miles of blue line stream according to the USGS McGuire Ridge 7.5 minute quadrangle. Unnamed Tributary to Dry Creek drains a watershed of approximately 5.3 square miles. Elevations range from about 200 feet at the mouth of the creek to 1,600 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via private roads located to the east of the town of Gualala.

S. Doyle and S. Green (Pacific States Marine Fisheries Commission) conducted the habitat inventory of August 15 - 21, 2001. The total length of the stream surveyed was 2,695 feet.

Unnamed Tributary to Dry Creek is an F4 channel type for the entire 2,186 feet of the stream surveyed and a B1 channel type for the remaining 509 feet of the stream surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. B1 channel types are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and bedrock channel. The suitability of F4 channel types for fish habitat improvements is as follows: good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors and channel constrictors; poor for boulder clusters. The suitability of B1 channel types for fish habitat improvement structures is as follows: excellent for bank-placed boulders; good for log-cover; poor for plunge weirs, single and opposing wing deflectors and boulder clusters.

Survey Data:
Location of Stream Mouth:
Survey Dates: 8/15/01 through 8/21/01
USGS Quad Map: McGuire Ridge Latitude: 38º 49' 54" Longitude: 123º 28' 17"

Stream Reach: 1
Channel Type: F4
Bankfull Width: 17 ft
Channel Length: 2186 ft
Riffle/Flatwater Mean Width: 8 ft
Total Pool Mean Depth: 0.7 ft
Base Flow: 0.1 cfs
Water Temperature: 59-65ºF
Air Temperature: 55-84ºF
Dominant Bank Vegetation: Coniferous Trees
Vegetative Cover: 61%
Dominant Bank Substrate: Bedrock
Embeddedness Value: 1: 38% 2: 34% 3: 6% 4: 0% 5: 22%
Canopy Density: 58%
Coniferous Component: 51%
Deciduous Component: 49%
Pools by Stream Length: 40%
Pools >= 3 ft Depth: 7%
Mean Pool Shelter Rating: 41
Dominant Shelter: Boulders
Occurrence of Large Organic Debris: 6%
Dry Channel: 0 ft

Stream Reach: 2
Channel Type: B1
Bankfull Width: 14 ft
Channel Length: 509 ft
Riffle/Flatwater Mean Width: 11 ft
Total Pool Mean Depth: 0.5 ft
Base Flow: 0.1 cfs
Water Temperature: 61-63ºF
Air Temperature: 70-76ºF
Canopy Density: 65%
Coniferous Component: 56%
Deciduous Component: 44%
Pools by Stream Length: 28%
Pools >= 3 ft Depth: 0%
Mean Pool Shelter Rating: 20
Dominant Shelter: Boulders
Occurrence of Large Organic Debris: 0%

Dominant Bank Vegetation: Coniferous Trees	Dry Channel: 0 ft
Vegetative Cover: 50%	
Dominant Bank Substrate: Bedrock	
Embeddedness Value: 1: 11% 2: 22% 3: 22% 4: 0% 5: 44%	

HAUPT CREEK

Haupt Creek is a tributary to the Wheatfield Fork, a tributary to the South Fork Gualala River, a tributary to the Gualala River, a tributary to the Pacific Ocean, located in Sonoma County, California. Haupt Creek's legal description at the confluence with the Wheatfield Fork is T10N R13W S33. Its location is 38?39?43? north latitude and 123?19?17.5? west longitude. Haupt Creek is a second order stream and has approximately 4.8 miles of blue line stream according to the USGS Annapolis 7.5 minute quadrangle. Haupt Creek drains a watershed of approximately 9.5 square miles. Elevations range from about 150 feet at the mouth of the creek to 1,200 feet in the headwater areas. Mixed hardwood and mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 1 to Kruse Ranch Road to Hauser Bridge Road to Tin Barn Road to the mouth of Haupt Creek.

K. VandenBranden and A. Palacios (Pacific States Marine Fisheries Commission) conducted the habitat inventory of October 6, 2001. The total length of the stream surveyed was 2,129 feet.

Haupt Creek is an F4 channel type for the entire 2,129 feet of the stream surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors and channel constrictors; poor for boulder clusters.

Survey Data:

Location of Stream Mouth:
Survey Dates: 10/06/01
USGS Quad Map: Annapolis   Latitude: 38º 39' 43''   Longitude: 123º 19' 17''

Stream Reach: 1	
Channel Type: F4	Canopy Density: 81%
Bankfull Width: 31.6 ft	Coniferous Component: 53%
Channel Length: 2129 ft	Deciduous Component: 47%
Riffle/Flatwater Mean Width: ft	Pools by Stream Length: 2%
Total Pool Mean Depth: 1.6 ft	Pools >= 3 ft Depth: 100%
Base Flow: 0 cfs	Mean Pool Shelter Rating: 285
Water Temperature: NA	Dominant Shelter: Large Woody Debris
Air Temperature: 68-68ºF	Occurrence of Large Organic Debris: 40%
Dominant Bank Vegetation: Coniferous Trees	Dry Channel: 2091 ft.
Vegetative Cover: 68%	
Dominant Bank Substrate: Boulder	
Embeddedness Value: 1: 0% 2: 0% 3: 0% 4: 0% 5: 100%	

HOUSE CREEK

House Creek is a tributary to the Wheatfield Fork, a tributary to the South Fork Gualala River, tributary to the Gualala River, tributary to the Pacific Ocean located in Sonoma County, California. House Creek's legal description at the confluence with the Wheatfield Fork is T10N R12W S06. Its location is 38?39?44? north latitude and 123?13?58? west longitude. House Creek is a third order stream and has approximately 11.8 miles of blue line stream according to the USGS Tombs Creek 7.5 minute quadrangle. House Creek drains a watershed of approximately 27.9 square miles. Elevations range from about 400 feet at the mouth of the creek to 1,200 feet in the headwater areas. Grassland and oak forest dominates the watershed. The watershed is entirely privately and is managed for timber production, rangeland, and agriculture. Vehicle access exists via Highway 1 to Kruse Ranch Road to Hauser Bridge Road to Tin Barn Road to the mouth of House Creek.

S. Green and M. Coleman (Pacific States Marine Fisheries Commission) conducted the habitat inventory of September 18 to October 5, 2001. The total length of the stream surveyed was 54,916 feet with an additional 3,040 feet of side channel.

House Creek is an F4 channel type for the entire 54,916 feet of the stream surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors and channel constrictors; poor for boulder clusters.

Survey Data:

Location of Stream Mouth:
Survey Dates: 9/18/01 through 10/5/01
USGS Quad Map: Tombs Creek Latitude: 38º 39' 45" Longitude: 123º 13' 57"

Stream Reach: 1	
Channel Type: F4	Canopy Density: 21%
Bankfull Width: 20.5 ft	Coniferous Component: 2%
Channel Length: 54916 ft	Deciduous Component: 98%
Riffle/Flatwater Mean Width: 12 ft	Pools by Stream Length: 14%
Total Pool Mean Depth: 1.7 ft	Pools >= 3 ft Depth: 63%
Base Flow: 0.3 cfs	Mean Pool Shelter Rating: 15
Water Temperature: 59-79ºF	Dominant Shelter: Boulders
Air Temperature: 53-97ºF	Occurrence of Large Organic Debris: 1%
Dominant Bank Vegetation: Deciduous Trees	Dry Channel: 51 ft
Vegetative Cover: 79%	
Dominant Bank Substrate: Silt/Clay/Sand	
Embeddedness Value: 1: 46% 2: 26% 3: 10% 4: 0% 5: 19%	

LITTLE NORTH FORK

Little North Fork Gualala River is a tributary to the North Fork Gualala River, a tributary to the Gualala River, tributary to the Pacific Ocean located in Mendocino County, California. Little North Fork Gualala River's legal description at the confluence with the North Fork Gualala River is T11N R15W S23. Its location is 38?47?28? north latitude and 123?30?31? west longitude. Little North Fork Gualala River is a second order stream and has approximately 4.2 miles of blue line stream according to the USGS Gualala 7.5 minute quadrangle. The Little North Fork of the Gualala River drains a watershed of approximately 6.6 square miles. Elevations range from about 190 feet at the mouth of the creek to 1,020 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 1 south to the town of Gualala and then travel east along the Gualala River to the North Fork of the Gualala and travel north along the North Fork Gualala River to the mouth of the Little North Fork Gualala River.

A. Palacios and K. VandenBranden (Pacific States Marine Fisheries Commission) conducted the habitat inventory of June 20 to August 2, 2001. The total length of the stream surveyed was 20,806 feet with an additional 1,404 feet of side channel.

Little North Fork Gualala River is an F4 channel type for the first 9,796 feet of the stream surveyed, a B4 channel type for the next 7,514 feet of stream surveyed and a B3 channel type for the remaining 3,496 feet of stream surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. B4 channel types are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and gravel dominant channel. B3 channel types are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and cobble dominant channel. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; poor for boulder clusters. The suitability of B4 channel types for fish habitat improvement structures is as follows: excellent for low-stage plunge weirs, boulder clusters, bank-placed boulders, single and opposing wing-deflectors and log cover. The suitability of B3 channel types for fish habitat improvement structures is as follows: excellent for plunge weirs, boulder clusters and bank placed boulder, single and opposing wing-deflectors, and log cover.

Stream Data:

Location of Stream Mouth:
Survey Dates: 6/20/01 through 8/2/01
USGS Quad Map: Gualala   Latitude: 38º 47' 28"   Longitude: 123º 30' 31"

Stream Reach: 1

Channel Type: F4	Canopy Density: 93%
Bankfull Width: ft	Coniferous Component: 51%
Channel Length: 9796 ft	Deciduous Component 49%
Riffle/Flatwater Mean Width: 9 ft	Pools by Stream Length: 56%
Total Pool Mean Depth: 0.9 ft	Pools >= 3 ft Depth: 12%
Base Flow: 0 cfs	Mean Pool Shelter Rating: 44
Water Temperature: 56-62ºF	Dominant Shelter: Root Masses
Air Temperature: 50-76ºF	Occurrence of Large Organic Debris: 12%
Dominant Bank Vegetation: Coniferous Trees	Dry Channel: 0 ft
Vegetative Cover: 76%	
Dominant Bank Substrate: Cobble/Gravel	

Embeddedness Value: 1: 54% 2: 39% 3: 5% 4: 0% 5: 2%

Stream Reach: 2

Channel Type: B4	Canopy Density: 90%
Bankfull Width: 15 ft	Coniferous Component: 36%
Channel Length: 7469 ft	Deciduous Component: 64%
Riffle/Flatwater Mean Width: 8 ft	Pools by Stream Length: 36%
Total Pool Mean Depth: 0.7 ft	Pools >= 3 ft Depth: 3%
Base Flow: 1.1 cfs	Mean Pool Shelter Rating: 53
Water Temperature: 56-64ºF	Dominant Shelter: Small Woody Debris
Air Temperature: 54-72ºF	Occurrence of Large Organic Debris: 14%
Dominant Bank Vegetation: Coniferous Trees	Dry Channel: 47 ft
Vegetative Cover: 73%	
Dominant Bank Substrate: Cobble/Gravel	

Embeddedness Value: 1: 36% 2: 55% 3: 6% 4: 1% 5: 2%

Stream Reach: 3

Channel Type: B3	Canopy Density: 94%
Bankfull Width: 12.4 ft	Coniferous Component: 47%
Channel Length: 3496 ft	Deciduous Component: 53%
Riffle/Flatwater Mean Width: 5 ft	Pools by Stream Length: 19%
Total Pool Mean Depth: 0.7 ft	Pools >= 3 ft Depth: 0%
Base Flow: 1.1 cfs	Mean Pool Shelter Rating: 65
Water Temperature: 56-60ºF	Dominant Shelter: Small Woody Debris
Air Temperature: 53-66ºF	Occurrence of Large Organic Debris: 18%
Dominant Bank Vegetation: Coniferous Trees	Dry Channel: 126

Vegetative Cover: 66%
Dominant Bank Substrate: Cobble/Gravel
Embeddedness Value: 1: 0% 2: 74% 3: 26% 4: 0% 5: 0%

UNNAMED TRIBUTARY TO THE LITTLE NORTH FORK

Unnamed Tributary to Little North Fork Gualala River is a tributary to the Little North Fork Gualala River, a tributary to the North Fork Gualala River, a tributary to the Gualala River, a tributary to the Gualala River, located in Mendocino County, California (Map 1). Unnamed Tributary to Little North Fork Gualala River's legal description at the confluence with the Little North Fork Gualala River is T11N R15W S14. Its location is 38?48?2.9? north latitude and 123?30?48? west longitude. Unnamed Tributary to Little North Fork Gualala River is a first order stream and has approximately 1.3 miles of blue line stream according to the USGS Gualala 7.5 minute quadrangle. Unnamed Tributary to Little North Fork Gualala River drains a watershed of approximately 0.6 square miles. Elevations range from about 200 feet at the mouth of the creek to 1,200 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 1 to the town of Gualala, east along the Gualala River and then north along the North Fork Gualala River to the Little North Fork Gualala River and to the mouth of the Unnamed Tributary to the Little North Fork Gualala River.

S. Doyle and S. Green (Pacific States Marine Fisheries Commission) conducted the habitat inventory of July 3 to July 5, 2001. The total length of the stream surveyed was 5,460 feet with an additional 50 feet of side channel.

Unnamed Tributary to Little North Fork Gualala River is an F4 channel type for the first 3,058 feet of the stream surveyed and an A4 channel type for the remaining 2,402 feet of stream surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. A4 channels are steep, narrow, cascading, step-pool streams with high energy/debris transport associated with depositional soils and gravel-dominant substrates. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; poor for boulder clusters. The suitability of A4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, opposing wing-deflectors, and log cover; poor for boulder clusters and single wing-deflectors.

Survey Data:

Location of Stream Mouth:
Survey Dates: 7/3/01 through 7/5/01
USGS Quad Map: Gualala Latitude: 38º 48' 30" Longitude: 123º 30' 48"

Stream Reach: 1

Channel Type: F4	Canopy Density: 95%
Bankfull Width: 9 ft	Coniferous Component: 61%
Channel Length: 3058 ft	Deciduous Component: 39%
Riffle/Flatwater Mean Width: 5 ft	Pools by Stream Length: 12%
Total Pool Mean Depth: 0.6 ft	Pools >= 3 ft Depth: 0%
Base Flow: 0.1 cfs	Mean Pool Shelter Rating: 51
Water Temperature: 54-58ºF	Dominant Shelter: Large Woody Debris
Air Temperature: 59-72ºF	Occurrence of Large Organic Debris: 37%
Dominant Bank Vegetation: Coniferous Trees	Dry Channel: 1844

Vegetative Cover: 88%
Dominant Bank Substrate: Cobble/Gravel
Embeddedness Value: 1: 35% 2: 29% 3: 29% 4: 6% 5: 0%

Stream Reach: 2

Channel Type: A4	Canopy Density: 94%
Bankfull Width: 8.3 ft	Coniferous Component: 65%
Channel Length: 2402 ft	Deciduous Component: 35%
Riffle/Flatwater Mean Width: 3 ft	Pools by Stream Length: 6%
Total Pool Mean Depth: 0.5 ft	Pools >= 3 ft Depth: 0%
Base Flow: 0.1 cfs	Mean Pool Shelter Rating: 33

Water Temperature: 54-58ºF	Dominant Shelter: Large Woody Debris
Air Temperature: 57-71ºF	Occurrence of Large Organic Debris: 60%
Dominant Bank Vegetation: Coniferous Trees	Dry Channel: 1819
Vegetative Cover: 83%	
Dominant Bank Substrate: Cobble/Gravel	
Embeddedness Value: 1: 29% 2: 14% 3: 21% 4: 0% 5: 36%	

LOG CABIN CREEK

Log Cabin Creek is a tributary to the Little North Fork Gualala River, a tributary to the North Fork Gualala River, a tributary to the Gualala River, a tributary to the Gualala River, a tributary to the Pacific Ocean, located in Mendocino County, California. Log Cabin Creek's legal description at the confluence with the Little North Fork Gualala River is T11N R15W S10. Its location is 39?48?57? north latitude and 123?31?25? west longitude. Log Cabin Creek is a first order stream and has approximately 1.3 miles of blue line stream according to the USGS Gualala 7.5 minute quadrangle. Log Cabin Creek drains a watershed of approximately 0.5 square miles. Elevations range from about 180 feet at the mouth of the creek to 1,200 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 1 to the town of Gualala, east along the Gualala River then north along the North Fork Gualala River and the Little North Fork Gualala River to the mouth of Log Cabin Creek.

K. VandenBranden and K. Morgan (Pacific States Marine Fisheries Commission) conducted the habitat inventory of August 3-10, 2001. The total length of the stream surveyed was 1,698 feet with an additional 23 feet of side channel.

Log Cabin Creek is a B4 channel type for the entire 1,698 feet of the stream surveyed. B4 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and gravel-dominant channel. The suitability of B4 channels for fish habitat improvement structures is as follows: excellent for low-stage plunge weirs, boulder clusters, bank-placed boulders, single and opposing wing-deflectors and log cover.

Survey Data:
Location of Stream Mouth:
Survey Dates: 8/3/01 through 8/10/01
USGS Quad Map: Gualala Latitude: 38º 48' 51" Longitude: 123º 31' 25"

Stream Reach:	1		
Channel Type:	B4	Canopy Density:	93%
Bankfull Width:	6.7 ft	Coniferous Component:	45%
Channel Length: 1	698 ft	Deciduous Component:	55%
Riffle/Flatwater Mean Width:	4 ft	Pools by Stream Length:	8%
Total Pool Mean Depth:	1.4 ft	Pools >= 3 ft Depth:	0%
Base Flow:	0 cfs	Mean Pool Shelter Rating:	43
Water Temperature:	56-59ºF	Dominant Shelter:	Small Woody Debris
Air Temperature:	60-63ºF	Occurrence of Large Organic Debris:	9%
Dominant Bank Vegetation: Coniferous Trees		Dry Channel: 187	
Vegetative Cover:	76%		
Dominant Bank Substrate: Silt/Clay/Sand			
Embeddedness Value:	**1:** 27% **2:** 67% **3:** 7% **4:** 0% **5:** 0%		

MARSHALL CREEK

Marshall Creek is a tributary to the South Fork Gualala River, a tributary to the Gualala River, located in Sonoma County, California. Marshall Creek's legal description at the confluence with the South Fork Gualala River is T09N R13W S27. Its location is 38?36?1? north latitude and 123?17?14? west longitude. Marshall Creek is a third order stream and has approximately 8.3 miles of blue line stream according to the USGS Plantation 7.5 minute quadrangle. Marshall Creek drains a watershed of approximately 19.7 square miles. Elevations range from about 480 feet at the mouth of the creek to 1,200 feet in the headwater areas. Mixed hardwood and mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for rural subdivision. Vehicle access exists via Highway 1 to Kruse Ranch Road to Hauser Bridge Road to the mouth of Marshall Creek.

A. Pothast and J. Richardson (Pacific States Marine Fisheries Commission) conducted the habitat inventory of September 5-14, 2001. The total length of the stream surveyed was 21,698 feet with 15,750 feet not surveyed due to access constraints.

Marshall Creek is an F4 channel type for the entire 21,698 feet of the stream surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates.

Survey Data:

Location of Stream Mouth:

Survey Dates: 9/5/01 through 9/14/01

USGS Quad Map: Plantation Latitude: 38º 36' 70" Longitude: 123º 17' 14"

Stream Reach: 1

Channel Type:	F4	Canopy Density:	57%
Bankfull Width:	31 ft	Coniferous Component:	55%
Channel Length:	3559 ft	Deciduous Component:	45%
Riffle/Flatwater Mean Width:	9 ft	Pools by Stream Length:	63%
Total Pool Mean Depth:	0.8 ft	Pools >= 3 ft Depth:	21%
Base Flow:	0 cfs	Mean Pool Shelter Rating:	14
Water Temperature:	62-62ºF	Dominant Shelter: Boulders	
Air Temperature:	63-63ºF	Occurrence of Large Organic Debris:	1%
Dominant Bank Vegetation: Deciduous Trees			
Dry Channel:	0 ft		
Vegetative Cover:	54%		

Dominant Bank Substrate: Silt/Clay/Sand

Embeddedness Value: **1:** 42% **2:** 26% **3:** 12% **4:** 0% **5:** 21%

Stream Reach:	2		
Channel Type:	F4	Canopy Density:	48%
Bankfull Width:	31 ft	Coniferous Component:	63%
Channel Length:	2389 ft	Deciduous Component:	37%
Riffle/Flatwater Mean Width:	10 ft	Pools by Stream Length:	64%
Total Pool Mean Depth:	1.2 ft	Pools >= 3 ft Depth:	36%
Base Flow:	0 cfs	Mean Pool Shelter Rating:	12
Water Temperature:	62-62ºF	Dominant Shelter: Boulders	
Air Temperature:	63-63ºF	Occurrence of Large Organic Debris:	6%
Dominant Bank Vegetation: Deciduous Trees		Dry Channel: 91 ft	
Vegetative Cover:	47%		

Dominant Bank Substrate: Silt/Clay/Sand

Embeddedness Value: **1:** 81% **2:** 19% **3:** 0% **4:** 0% **5:** 0%

McGANN CREEK

McGann Creek is a tributary to the North Fork Gualala River, a tributary to the Gualala River, tributary to the Pacific Ocean, located in Mendocino County, California. McGann Creek's legal description at the confluence with the North Fork Gualala River is T11N R14W S07. Its location is 38?48?40? north latitude and 123?28?25? west longitude. McGann Creek is a first order stream and has approximately 2.0 miles of blue line stream according to the USGS McGuire Ridge 7.5 minute quadrangle. McGann Creek drains a watershed of approximately 1.4 square miles. Elevations range from about 195 feet at the mouth of the creek to 1,200 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 1 to the town of Gualala, east along the Gualala River then north along the North Fork Gualala River to the mouth of McGann Creek.

S. Doyle and S. Green (Pacific States Marine Fisheries Commission) conducted the habitat inventory of August 2, 2001. The total length of the stream surveyed was 1,980 feet.

No channel type was taken on McGann Creek.

Survey Data:			
Location of Stream Mouth:			
Survey Dates: 8/2/01 through 8/2/01			
USGS Quad Map: McGuire Ridge	Latitude: 38º 48' 40"	Longitude:	123º 28' 25"
Stream Reach:	1		
Channel Type:		Canopy Density:	80%
Bankfull Width:	ft	Coniferous Component:	38%
Channel Length:	1980 ft	Deciduous Component:	63%
Riffle/Flatwater Mean Width:	5 ft	Pools by Stream Length:	3%
Total Pool Mean Depth:	0.5 ft	Pools >= 3 ft Depth:	0%
Base Flow:	0 cfs	Mean Pool Shelter Rating:	5
Water Temperature:	59-59ºF	Dominant Shelter:	Large Woody Debris
Air Temperature:	67-67ºF	Occurrence of Large Organic Debris:	28%
Dominant Bank Vegetation: Deciduous Trees			
Dry Channel:	1737ft		
Vegetative Cover:	73%		
Dominant Bank Substrate: Silt/Clay/Sand			
Embeddedness Value: **1:** 0% **2:** 0% **3:** 100% **4:** 0% **5:** 0%			

NORTH FORK

North Fork Gualala River is a tributary to the Gualala River, a tributary to the Pacific Ocean, located in Mendocino County, California. North Fork Gualala River's legal description at the confluence with the Gualala River is T11N R15W S26. Its location is 38?46?41? north latitude and 123?29?51? west longitude. North Fork Gualala River is a fourth order stream and has approximately 13.6 miles of blue line stream according to the USGS McGuire Ridge 7.5 minute quadrangle. North Fork Gualala River drains a watershed of approximately 40.3 square miles. Elevations range from about 200 feet at the mouth of the creek to 1,400 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 1 to the town of Gualala and then east along the Gualala River to the mouth of the North Fork Gualala River.

J. Richardson and A. Pothast (Pacific States Marine Fisheries Commission) conducted the habitat inventory of July 24 to August 30, 2001. The total length of the stream surveyed was 59,362 feet with an additional 7,617 feet of side channel.

North Fork Gualala River is an F4 channel type for the entire 59,362 feet of the stream surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; poor for boulder clusters.

Survey Data:

Location of Stream Mouth:
Survey Dates: 7/24/01 through 8/30/01
USGS Quad Map: McGuire Ridge Latitude: 38º 46' 41" Longitude: 123º 29' 51"

Stream Reach: 1

Channel Type: F4	Canopy Density: 77%
Bankfull Width: 61.4 ft	Coniferous Component: 39%
Channel Length: 59362 ft	Deciduous Component: 61%
Riffle/Flatwater Mean Width: 15 ft	Pools by Stream Length: 67%
Total Pool Mean Depth: 1.1 ft	Pools >= 3 ft Depth: 43%
Base Flow: 3.5 cfs	Mean Pool Shelter Rating: 28
Water Temperature: 58-74ºF	Dominant Shelter: Terrestrial Vegetation
Air Temperature: 52-87ºF	Occurrence of Large Organic Debris: 7%
Dominant Bank Vegetation: Coniferous Trees	Dry Channel: 30 ft
Vegetative Cover: 81%	
Dominant Bank Substrate: Silt/Clay/Sand	

Embeddedness Value: 1: 59% 2: 27% 3: 6% 4: 0% 5: 8%

PALMER CANYON CREEK

Palmer Canyon Creek is a tributary to Marshall Creek, a tributary to the South Fork Gualala River, located in Mendocino County, California. Palmer Canyon Creek's legal description at the confluence with Marshall Creek is T19N R12W S31. Its location is 38°52?3.1? north latitude and 123°13?2 3.23? west longitude. Palmer Canyon Creek is a first order stream and has approximately 0.5 miles of blue line stream according to the USGS Fort Ross 7.5 minute quadrangle. Palmer Canyon Creek drains a watershed of approximately 0.96 square miles. Elevations range from about 547 feet at the mouth of the creek to 755 feet in the headwater areas. Grassland and mixed forest dominate the watershed. The entire watershed is privately owned and is managed for rural subdivisions. Vehicle access exists via Highway 1 to Fort Ross Road to Meyers Grade Road to private roads to the mouth of Palmer Canyon Creek.

A. Pothast and J. Richardson (Pacific States Marine Fisheries Commission) conducted the habitat inventory of September 18, 2001. The total length of the stream surveyed was 395 feet.

Palmer Canyon Creek is a B4 channel type for the entire 395 feet of the stream surveyed. B4 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and cobble-dominant channel. The suitability of B4 channels for fish habitat improvement structures is as follows: excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover.

Survey Data:

Location of Stream Mouth:
Survey Dates: 9/18/01 through 9/18/01
USGS Quad Map: McGuire Ridge Latitude: 38º 52' 3.1" Longitude: 123º 13' 23.23"

Stream Reach: 1	
Channel Type: B4	Canopy Density: 82%
Bankfull Width: 17.8 ft	Coniferous Component: 43%
Channel Length: 395 ft	Deciduous Component: 57%
Riffle/Flatwater Mean Width: 7 ft	Pools by Stream Length: 35%
Total Pool Mean Depth: 0.7 ft	Pools >= 3 ft Depth: 11%
Base Flow: 0.1 cfs	Mean Pool Shelter Rating: 12
Water Temperature: 62-64ºF	Dominant Shelter: Boulders
Air Temperature: 66-74ºF	Occurrence of Large Organic Debris: 0%
Dominant Bank Vegetation: Deciduous Trees	Dry Channel: 14 ft
Vegetative Cover: 62%	
Dominant Bank Substrate: Cobble/Gravel	
Embeddedness Value: 1: 36% 2: 27% 3: 27% 4: 0% 5: 9%	

PEPPERWOOD CREEK

Pepperwood Creek is a tributary to House Creek, a tributary to the Wheatfield Fork, a tributary to the Gualala River, a tributary to the Pacific Ocean, located in Sonoma County, California. Pepperwood Creek's legal description at the confluence with House Creek is T10N R12W S07. Its location is 38?13?1? north latitude and 123?13?1? west longitude. Pepperwood Creek is a third order stream and has approximately 3.7 miles of blue line stream according to the USGS Tombs Creek 7.5 minute quadrangle. Pepperwood Creek drains a watershed of approximately 12.7 square miles. Elevations range from about 400 feet at the mouth of the creek to 1,600 feet in the headwater areas. Grassland and oak forest dominates the watershed. The watershed is entirely privately owned and is managed for agriculture. Vehicle access exists via Highway 1 to Kruse Ranch Road to Hauser Bridge Road to Tin Barn Road to the mouth of Pepperwood Creek.

S. Green and M. Coleman (Pacific States Marine Fisheries Commission) conducted the habitat inventory of October 10-16, 2001. The total length of the stream surveyed was 17,931 feet with an additional 627 feet of side channel.

Pepperwood Creek is an F4 channel type for the entire 17,931 feet of the stream surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; poor for boulder clusters.

Survey Data:

Location of Stream Mouth:

Survey Dates:	10/9/01 through 10/16/01		
USGS Quad Map: Tombs Creek	Latitude: 38º 38' 8"	Longitude:	123º 13' 0"
Stream Reach:	1		
Channel Type:	F4	Canopy Density: 9%	
Bankfull Width:	ft	Coniferous Component: 5%	
Channel Length:	17931 ft	Deciduous Component: 95%	
Riffle/Flatwater Mean Width:	9 ft	Pools by Stream Length: 18%	
Total Pool Mean Depth:	1.3 ft	Pools >= 3 ft Depth: 52%	
Base Flow:	0 cfs	Mean Pool Shelter Rating: 13	
Water Temperature:	57-70ºF	Dominant Shelter: Boulders	

Air Temperature:	46-82ºF	Occurrence of Large Organic Debris:	1%
Dominant Bank Vegetation: Deciduous Trees			
Dry Channel:	2106ft		
Vegetative Cover:	68%		
Dominant Bank Substrate: Bedrock			
Embeddedness Value: **1:** 38% **2:** 38% **3:** 9% **4:** 0% **5:** 16%			

ROBINSON CREEK

Robinson Creek is a tributary to the North Fork Gualala River, a tributary to the Gualala River, a tributary to the Pacific Ocean, located in Mendocino County, California. Robinson Creek's legal description at the confluence with the North Fork Gualala River is T11N R15W S12. Its location is 38?49?18.9? north latitude and 123?29?1.7? west longitude. Robinson Creek is a first order stream and has approximately 0.8 miles of blue line stream according to the USGS McGuire Ridge 7.5 minute quadrangle. Robinson Creek drains a watershed of approximately 0.8 square miles. Elevations range from about 200 feet at the mouth of the creek to 1,800 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 1 to the town of Gualala, east along the Gualala River then northeast along the North Fork Gualala River to the mouth of Robinson Creek.

S. Green and S. Doyle (Pacific States Marine Fisheries Commission) conducted the habitat inventory of July 24 to August 1, 2001. The total length of the stream surveyed was 7,819 feet with an additional 134 feet of side channel.

Robinson Creek is a B4 channel type for the entire 7,819 feet of the stream surveyed. B4 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and cobble-dominant channel. The suitability of B4 channels for fish habitat improvement structures is as follows: excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover.

Survey Data:			
Location of Stream Mouth:			
Survey Dates:	7/24/01 through 8/1/01		
USGS Quad Map: McGuire Ridge	Latitude: 38º 48' 40"	Longitude:	123º 28' 56"
Stream Reach:	1		
Channel Type:	B4	Canopy Density:	66%
Bankfull Width:	13.5 ft	Coniferous Component:	39%
Channel Length:	7819 ft	Deciduous Component:	61%
Riffle/Flatwater Mean Width:	7 ft	Pools by Stream Length:	19%
Total Pool Mean Depth:	0.8 ft	Pools >= 3 ft Depth:	3%
Base Flow:	0 cfs	Mean Pool Shelter Rating:	66
Water Temperature:	55-66ºF	Dominant Shelter:	Large Woody Debris
Air Temperature:	53-72ºF	Occurrence of Large Organic Debris:	29%
Dominant Bank Vegetation: Coniferous Trees			
Dry Channel: 2171ft			
Vegetative Cover:	85%		
Dominant Bank Substrate: Cobble/Gravel			
Embeddedness Value: **1:** 18% **2:** 51% **3:** 29% **4:** 2% **5:** 0%			

ROCKPILE CREEK

Rockpile Creek is a tributary to the South Fork Gualala River, a tributary to the Gualala River, tributary to the Pacific Ocean, located in Sonoma County, California. Rockpile Creek's legal description at the confluence with the South Fork Gualala River is T11N R14W S31. Its location is 38?45?66? north latitude and 123?28?10? west longitude. Rockpile Creek is a third order stream and has approximately 21.3 miles of blue line stream according to the USGS McGuire Ridge 7.5 minute quadrangle. Rockpile Creek drains a watershed of approximately 35 square miles. Elevations range from about 195 feet at the mouth of the creek to 1,600 feet in the headwater areas. Mixed hardwood and mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production.

Vehicle access exists via Highway 1 to the town of Gualala and then south along the South Fork Gualala River to the mouth of Rockpile Creek.

S. Green, S. Doyle, D. Katanjak and M. Coleman (Pacific States Marine Fisheries Commission) conducted the habitat inventory of August 23 to September 14, 2001. The total length of the stream surveyed was 44,500 with 17,332 feet not surveyed due to access constraints. There was an additional 2,077 feet of side channel surveyed.

Rockpile Creek is an F4 channel type for 27,168 feet of the stream surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; poor for boulder clusters.

Survey Data:

Location of Stream Mouth:
Survey Dates: 8/23/01 through 9/14/01
USGS Quad Map: McGuire Ridge Latitude: 38º 45' 2" Longitude: 123º 28' 11"

Stream Reach: 1	
Channel Type: F4	Canopy Density: 58%
Bankfull Width: 75.6 ft	Coniferous Component: 23%
Channel Length: 27168 ft	Deciduous Component: 77%
Riffle/Flatwater Mean Width: 14 ft	Pools by Stream Length: 30%
Total Pool Mean Depth: 1.4 ft	Pools >= 3 ft Depth: 29%
Base Flow: 0.7 cfs	Mean Pool Shelter Rating: 41
Water Temperature: 63-66ºF	Dominant Shelter: Boulders
Air Temperature: 49-77ºF	Occurrence of Large Organic Debris: 11%
Dominant Bank Vegetation: Coniferous Trees	Dry Channel: 1853
Vegetative Cover: 90%	
Dominant Bank Substrate: Silt/Clay/Sand	
Embeddedness Value: 1: 17% 2: 35% 3: 30% 4: 0% 5: 19%	

SOUTH FORK

South Fork Gualala River is a tributary to the Gualala River, a tributary to the Pacific Ocean, located in Sonoma County, California. South Fork Gualala River's legal description at the confluence with the Gualala River is T11N R15W S26. Its location is 38?46?42? north latitude and 123?29?52? west longitude. South Fork Gualala River is a fourth order stream and has approximately 35.7 miles of blue line stream according to the USGS McGuire Ridge 7.5 minute quadrangle. South Fork Gualala River drains a watershed of approximately 247.5 square miles. Elevations range from about 200 feet at the mouth of the creek to 1,400 feet in the headwater areas. Mixed hardwood, mixed conifer forest, and grassland dominates the watershed. The watershed is entirely privately owned and is managed for timber production, rangeland, and agriculture. Vehicle access exists via Highway 1 to the town of Gualala and then east along the Gualala River to the mouth of the South Fork of the Gualala River.

A. Pothast and J. Richardson (Pacific States Marine Fisheries Commission) conducted the habitat inventory of September 20 to 26, 2001. The total length of the stream surveyed was 8,451 feet.

South Fork Gualala River is an F4 channel type for the entire 8,451 feet of the stream surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. The suitability of F4 channels for fish habitat improvement structures is as follows: good for bank placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; poor for boulder clusters.

Survey Data:

Location of Stream Mouth:
Survey Dates: 9/20/01 through 9/26/01
USGS Quad Map: McGuire Ridge Latitude: 38º 46' 42" Longitude: 123º 29' 52"

Stream Reach: 1	
Channel Type: F4	Canopy Density: 96%

Bankfull Width: 15.8 ft	Coniferous Component: 26%
Channel Length: 8451 ft	Deciduous Component: 74%
Riffle/Flatwater Mean Width: 4 ft	Pools by Stream Length: 36%
Total Pool Mean Depth: 0.6 ft	Pools >= 3 ft Depth: 6%
Base Flow: 0 cfs	Mean Pool Shelter Rating: 22
Water Temperature: 52-67ºF	Dominant Shelter: Boulders
Air Temperature: 45-79ºF	Occurrence of Large Organic Debris: 1%
Dominant Bank Vegetation: Deciduous Trees	Dry Channel: 3144
Vegetative Cover: 63%	
Dominant Bank Substrate: Silt/Clay/Sand	
Embeddedness Value: 1: 64% 2: 9% 3: 10% 4: 0% 5: 17%	

TOMBS CREEK

Tombs Creek is a tributary to the Wheatfield Fork, tributary to the South Fork Gualala River, tributary to the Gualala River, tributary to the Pacific Ocean, located in Sonoma County, California. Tombs Creek's legal description at the confluence with the Wheatfield Fork is T10N R12W S18. Its location is 38?43?4? north latitude and 123?14?25? west longitude. Tombs Creek is a second order stream and has approximately 8.5 miles of blue line stream according to the USGS Tombs Creek 7.5 minute quadrangle. Tombs Creek drains a watershed of approximately 9.7 square miles. Elevations range from about 960 feet at the mouth of the creek to 2,200 feet in the headwater areas. Grassland and oak forest dominates the watershed. The watershed is entirely privately owned and is managed for agriculture and rangeland. Vehicle access exists via Highway 1 to Annapolis Road to Wheatfield Fork and private roads to the mouth of Tombs Creek.

A. Palacios and K. VandenBranden (Pacific States Marine Fisheries Commission) conducted the habitat inventory of September 19 to October 12, 2001. The total length of the stream surveyed was 37,359 feet.

Tombs Creek is a B4 channel type for the entire 37,539 feet of the stream surveyed. B4 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and gravel dominant channel. The suitability of B4 channel types for fish habitat improvement is as follows: excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover.

Survey Data:		
Location of Stream Mouth:		
Survey Dates: 9/19/01 through 10/12/01		
USGS Quad Map: Tombs Creek	Latitude: 38º 43' 5"	Longitude: 123º 14' 26"
Stream Reach: 1		
Channel Type: B4		Canopy Density: 65%
Bankfull Width: 31.6 ft		Coniferous Component: 30%
Channel Length: 37539 ft		Deciduous Component: 70%
Riffle/Flatwater Mean Width: 8 ft		Pools by Stream Length: 24%
Total Pool Mean Depth: 1 ft		Pools >= 3 ft Depth: 11%
Base Flow: 0 cfs		Mean Pool Shelter Rating: 51
Water Temperature: 52-76ºF		Dominant Shelter: Boulders
Air Temperature: 53-88ºF		Occurrence of Large Organic Debris: 3%
Dominant Bank Vegetation: Deciduous Trees		Dry Channel: 1704
Vegetative Cover: 60%		
Dominant Bank Substrate: Cobble/Gravel		
Embeddedness Value: 1: 6% 2: 51% 3: 27% 4: 0% 5: 16%		

WHEATFIELD FORK

Wheatfield Fork is a tributary to the South Fork Gualala River, a tributary to the Gualala River, located in Sonoma County, California. Wheatfield Fork's legal description at the confluence with Gualala River is T10N R14W S21. Its location is 38?42?4.4? north latitude and 123?24?53.9? west longitude. Wheatfield Fork is a fourth order stream and has approximately 28.8 miles of blue line stream according to the USGS Stewarts Point 7.5 minute quadrangle. Wheatfield Fork drains a watershed of approximately 111.6 square miles. Elevations range from about 200 feet at the mouth of the creek to 1,500 feet in the headwater areas. Mixed hardwood/mixed conifer forest and grassland dominates the watershed. The watershed is entirely privately owned and is managed for timber production, rangeland, and agriculture. Vehicle access exists via Highway 1 south to Annapolis Road to the mouth of Wheatfield Fork.

J. Richardson and A. Pothast (Pacific State s Marine Fisheries Commission) conducted the habitat inventory of September 27, 2001 through November 1, 2001. The total length of the stream surveyed was 116,878 feet (10,032 feet of this length was not surveyed due to access constraints) with an additional 10,026 feet of side channel.

Wheatfield Fork is an F4 channel type for the entire 106,846 feet of the stream surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. The suitability of F4 channel types for fish habitat improvement structures is as follows: good for bank placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; poor for boulder clusters.

Survey Data:

Location of Stream Mouth:
Survey Dates: 9/27/01 through 11/1/01
USGS Quad Map: Stewarts Point Latitude: 38º 42' 5" Longitude: 123º 24' 54"

Stream Reach: 1

Channel Type: F4	Canopy Density: 52%
Bankfull Width: 90 ft	Coniferous Component: 58%
Channel Length: 82188 ft	Deciduous Component: 42%
Riffle/Flatwater Mean Width: 15 ft	Pools by Stream Length: 70%
Total Pool Mean Depth: 1 ft	Pools >= 3 ft Depth: 45%
Base Flow: 0 cfs	Mean Pool Shelter Rating: 16
Water Temperature: 50-67ºF	Dominant Shelter: Small Woody Debris
Air Temperature: 41-78ºF	Occurrence of Large Organic Debris: 3%
Dominant Bank Vegetation: Deciduous Trees	Dry Channel: 4791
Vegetative Cover: 73%	
Dominant Bank Substrate: Silt/Clay/Sand	
Embeddedness Value: 1: 16% 2: 26% 3: 24% 4: 18% 5: 16%	

Stream Reach: 2

Channel Type: F4	Canopy Density: 27%
Bankfull Width: 90 ft	Coniferous Component: 18%
Channel Length: 5701 ft	Deciduous Component: 82%
Riffle/Flatwater Mean Width: 22 ft	Pools by Stream Length: 41%
Total Pool Mean Depth: 0.8 ft	Pools >= 3 ft Depth: 26%
Base Flow: 0 cfs	Mean Pool Shelter Rating: 20
Water Temperature: 53-65ºF	Dominant Shelter: Terrestrial Vegetation
Air Temperature: 42-82ºF	Occurrence of Large Organic Debris: 0%
Dominant Bank Vegetation: Deciduous Trees	Dry Channel: 0 ft
Vegetative Cover: 39%	
Dominant Bank Substrate: Silt/Clay/Sand	
Embeddedness Value: 1: 0% 2: 48% 3: 24% 4: 12% 5: 16%	

Stream Reach: 3

Channel Type: F4	Canopy Density: 21%
Bankfull Width: 90 ft	Coniferous Component: 18%
Channel Length: 18988 ft	Deciduous Component: 82%
Riffle/Flatwater Mean Width: 21 ft	Pools by Stream Length: 47%

Total Pool Mean Depth: 1.4 ft	Pools >= 3 ft Depth: 40%
Base Flow: 0 cfs	Mean Pool Shelter Rating: 10
Water Temperature: 50-65ºF	Dominant Shelter: Boulders
Air Temperature: 41-69ºF	Occurrence of Large Organic Debris: 0%
Dominant Bank Vegetation: Deciduous Trees	Dry Channel: 0 ft
Vegetative Cover: 52%	
Dominant Bank Substrate: Silt/Clay/Sand	
Embeddedness Value: 1: 4% 2: 44% 3: 36% 4: 6%	5: 10%

ATTACHMENT G: FISHERIES SURVEYS TABLE

Table 35: Fisheries Surveys of the Gualala River, California.

Year	Stream	Type of Survey
1954-1955	Lower South Fork	Creel Surveys
1962	Lower South Fork	Creel Surveys
1964	Lower South Fork	Stream Survey
mid 1970's	Lower South Fork	5 year study using creel surveys, use counts, adult tagging and downstream migrant trapping
1983	Robinson Creek	3 Pass E-Fishing
1984	Estuary	Beach Seine
1985	Estuary	Beach Seine
1986	Estuary	Beach Seine
1988	Little North Fork	3 Pass E-Fishing
1989	Little North Fork	3 Pass E-Fishing
1989	Fuller Creek	2 or 3 Pass E-Fishing
1989	SF Fuller Creek	2 or 3 Pass E-Fishing
1990	Little North Fork	3 Pass E-Fishing
1991	Little North Fork	3 Pass E-Fishing
1992	Little North Fork	3 Pass E-Fishing
1993	Little North Fork	3 Pass E-Fishing
1995	Little North Fork	3 Pass E-Fishing
1995	Fuller Creek	1 Pass E-Fishing
1995	SF Fuller Creek	1 Pass E-Fishing
1997	Buckeye Creek	Snorkel
1997	South Fork	Snorkel
1998	Little North Fork	3 Pass E-Fishing
1998	Little North Fork	Snorkel
1998	Wheatfield Fork	Snorkel
1998	Buckeye Creek	Snorkel
1998	South Fork	Snorkel
1999	Little North Fork	Snorkel
1999	Robinson Creek	Snorkel
1999	North Fork	Snorkel
1999	Dry Creek	Snorkel
1999	Little North Fork	3 Pass E-Fishing
1999	Little North Fork	Spawner Survey
2000	Little North Fork	3 Pass E-Fishing
2000	Little North Fork	Spawner Survey
2000	Little North Fork	Snorkel
2000	Robinson Creek	Snorkel
2000	North Fork	Snorkel
2000	Dry Creek	Snorkel
2000	Buckeye Creek	Snorkel
2000	South Fork	Snorkel
2001	Rockpile Creek	Spawner Survey
2001	Wheatfield Fork	Spawner Survey
2001	Haupt Creek	Spawner Survey

2001	Tombs Creek	Spawner Survey
2001	Britian Creek	Spawner Survey
2001	House Creek	Spawner Survey
2001	South Fork	Spawner Survey
2001	Little North Fork	Snorkel
2001	Robinson Creek	Snorkel
2001	North Fork	Snorkel
2001	Dry Creek	Snorkel
2001	Buckeye Creek	Snorkel
2001	South Fork	Snorkel
2001	North Fork	Modified 10 Pool Protocol E-Fishing
2001	Franchini Creek	Modified 10 Pool Protocol E-Fishing
2001	Wheatfield Fork	Modified 10 Pool Protocol E-Fishing
2001	Haupt Creek	Modified 10 Pool Protocol E-Fishing
2001	Tombs Creek	Modified 10 Pool Protocol E-Fishing
2001	House Creek	Modified 10 Pool Protocol E-Fishing
2001	Pepperwood Creek	Modified 10 Pool Protocol E-Fishing
2001	South Fork	Modified 10 Pool Protocol E-Fishing
2001	Marshall Creek	Modified 10 Pool Protocol E-Fishing
2001	Doty Creek	Modified 10 Pool Protocol E-Fishing

ATTACHMENT H: MACROINVERTEBRATE

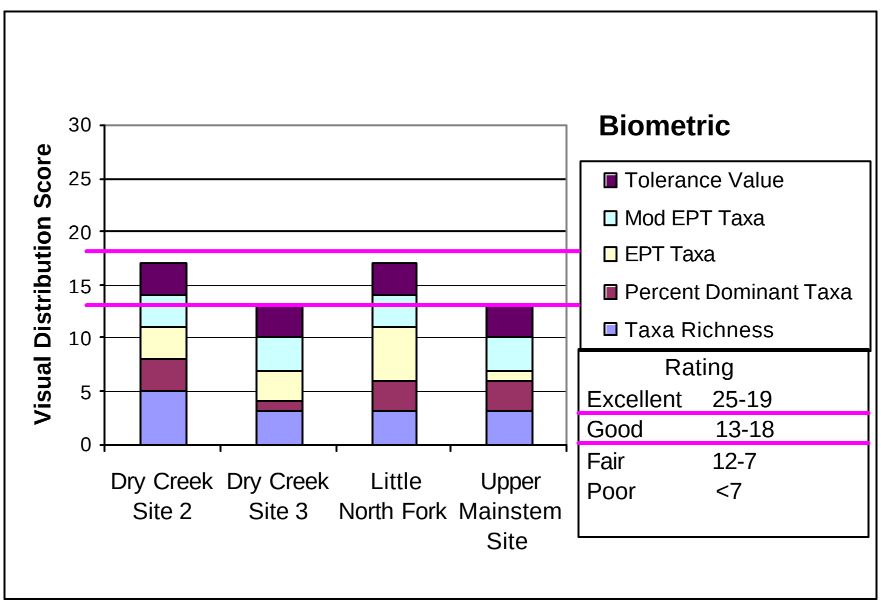
Freshwater benthic macroinvertebrates include worms, snails, clams, crustaceans, aquatic beetles, the nymph form of mayflies, stoneflies, dragonflies, damselflies, the larval form of caddis flies and true flies. They are a minimum of 0.5 mm in length and live primarily on instream boulder, cobble or gravel substrate. They readily categorized into feeding guilds, species that obtain a common food source in a similar manner. The most common feeding guilds are shredders, filter-collectors, collect-gatherers, scrapers-grazers, and predators.

The physical structure of rivers and streams are measured by stream order, which is related to watershed size. Stream order influences the assemblage of benthic macroinvertebrates. The Gualala River mainstem is a fourth order stream. Tributaries to the Gualala River are largely first, second and third order streams. The predominant feeding guilds in fourth order streams are; scrapers, which consume the algal growth associated with a more open canopy cover; and collectors, utilizing the high amount of fine particulate organic matter that has drifted downstream. Shredders, which process leaf litter and other forest debris, and collectors, which further process shredder excrement, usually dominate first and second order streams.

Benthic macroinvertebrate biotic condition is commonly measured by species richness, species composition, and tolerance/intolerance metrics. Tolerance measures reflect the sensitivity of the community to aquatic sensitivity. Species richness and composition tend to decrease in response to habitat disturbance. Harrington (2000) developed the Russian River Index of Biological Integrity, which includes six metrics: taxa richness, percent dominant taxa, EPT taxa, modified EPT taxa, Shannon diversity and tolerance value. EPT refers to the taxa of Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) insect orders. Shannon diversity index is a quantitative measure of habitat diversity. These six metrics integrate into a single score and were compared to determine biotic condition categories: excellent (30-24), good (23-18), fair (17-12), and poor (11-6).

Gualala Redwoods, Inc. provided benthic macroinvertebrate data from three replicate samples collected at four sites: two sites on Dry Creek; one site on the Little North Fork; one site on mainstem Gualala. The mean value biological metrics from these sites were compared to determine biotic condition. The Shannon Diversity metric was unavailable and not included in the score. Thus biotic rating categories shown in below have been decreased by five points to allow evaluation of the data. The ratings are excellent (25-19), good (18-13), fair (12-7), and poor (<7) (A. Rehn, pers comm). The sites sampled on Dry Creek, Little North Fork and the mainstem Gualala indicate a "good biotic condition" (Fig. 47).

Fig. 35: Gualala River Basin macro invertebrate biological integrity index, 2001.



ATTACHMENT I: ESTUARY PLANT SURVEY

Table 36: Riparian vegetation inventory of the Gualala River Estuary/Coastal Lagoon, February, 2002.

LOCATION	COMMON NAME	Scientific Name
North side of Estuary	Lupine	*Lupines spp.*
	Fennel	*Foeniculum vulgare*
	Himalaya Berry	*Rebus thrysauthus*
	California Blackberry	*Rubus vitifolius*
	Thimble Berry	*Rubus parviflorus*
	Coyote brush	*Baccharis pilularus*
	Rush	*Juncus spp.*
	Pennyroyal	*Mentha spp.*
	Teasel	*Dipsacus fullonum*
	Horseta il	*Equisetem spp.*
	Swordfern	*Polystichum munitum*
	Mugwort	*Artemisia douglasiana*
	Bull Thistle	*Cirsium vulgare*
	Cow Parsnips	*Heracleum lanatum*
	Stinging Nettle	*Urtica gracilis*
	Dead Nettle	*Lamium spp.*
	Small Flowered Nightshade	*Solanum spp.*
	Stachys	*Stachys spp.*
	Wild Radish	*Raphanus sativus*
	Yarrow	*Achillea millefolium*
	Horseweed	*Conyza spp.*
	Alder	*Alnus rubra*
	Poison Hemlock	*Conium maculatum*
	English Ivy	*Hedera helix*
	Bay Laurel	*Umbellularia californica*
	Dock	*Rumex spp.*
	Nut Sedge	*Cyperus spp.*
	Grass perennial	
	Reed (water)	
South side of Estuary		
	Lupine	*Lupines spp.*
	Coyote brush	*Baccharis pilularus*
	Teasel	*Dipsacus fullonum*
	California Iris	*Iris douglasiana*
	Pacific Madrone	*Arbutus edulis*
	Grand Fir	*Abies grandis*
	Swordfern	*Polystichum munitum*
	Rush	*Juncus spp.*
	Grass perennial	
	Nut Sedge	*Cyperus spp.*
	Dock	*Rumex spp.*
	Stinging Nettle	*Urtica gracilis*

	Thimble Berry	*Rubus parviflorus*
	Alder	*Alnus rubra*
	Poison Hemlock	*Conium maculatum*
	Horsestail	*Equisetem spp.*
	Dead Nettle	*Lamium spp.*
	California Blackberry	*Rubus vitifolius*
	Bull Thistle	*Cirsium vulgare*
Island		
	Pampas Grass	*Cortaderia jubata*
	Dunegrass	*Unsure*
	Reed (water)	*Unsure*
Dunes		
	Iceplant	*Carpobrotus edulis*
	Lupine	*Lupines spp.*
	Plantain	*Plantago lanceolata*
	Coyote brush	*Baccharis pilularus*
	Sand Verbena	*Abronia latifolia*
	Yarrow	*Achillea millefolium*

ATTACHMENT J: RECOMMENDED FUTURE HABITAT SURVEYS

Recommendations for future habitat inventory surveys based on *Assessment of Anadromous Salmonids and Stream Habitat Conditions Of The Gualala River Basin*.Habitat inventories have not been conducted in the headwaters tributaries and upper reaches of many streams in the five subbasins. Table X lists, by subbasin, the blue line streams that have potential salmonid spawning habitat.

SUBBASIN Stream	Stream Order	Miles to be Surveyed
NORTH FORK		
North Fork	2	5.0
Robinson Creek 2	1	1.3
Billings Creek	1	4.5
Unamed Trib to Billings Creek	1	1.0
Bear Creek	1	1.3
ROCKPILE		
Rockpile Creek	2	17.8
BUCKEYE		
Franchini Creek	1	2.0
Porter Creek	1	0.3
Soda Springs	1	1.5
NF Buckeye Creek	2	5.0
Osser Creek	1	2.0
Flat Ridge Creek	1	1.9
Grasshopper Creek	1	4.1
Little Creek	1	3.0
WHEATFIELD		
Haupt Creek	2	5.0
Wolf Creek	1	3.7
Spanish Creek	1	0.9
Britain Creek	1	2.8
Cedar Creek	1	3.0

Wheatfield Fork headwaters Trib	1	1.1
Wheatfield Fork to headwaters	2	8.8
Unamed Trib to Wheatfield Fork	1	0.4
Grasshopper Creek	1	0.6
Jim Creek	1	1.0
SOUTH FORK		
South Fork	2	26.2
Turner Canyon Creek	1	0.8
Sproule Creek	1	1.2

ATTACHMENT H: FISH RESTORATION PROJECTS

Completed and In-Progress Fish Restoration projects on the Gualala River Watershed funded by the California Department of Fish and Game, Fishery Restoration Grants Program

Approved Projects, FY 2001-02 Funds

BASINWIDE

Sotoyome Resource Conservation District Gualala River Watershed Outreach and Education Program
Organization Support
$97,619 funded $108,989 total project cost

NORTH FORK, ROCKPILE CREEK, BUCKEYE CREEK

Sotoyome Resource Conservation District Gualala River Wood in the Stream Phase III
Instream Habitat Improvement
$20,284 funded $43,534 total project cost

LITTLE NORTH FORK

Sotoyome Resource Conservation District Little North Fork Sediment Reduction Project
Upslope Sediment Source Remediation
$283,197 funded $556,792 total project cost

SOUTH FORK (Gualala Ranch area)

Pacific Watershed Associates: Ward Creek/South Fork Gualala Sediment Reduction
Upslope Sediment Source Remediation
$351,299 funded $387,337 total project cost (about half of the sites are in Gualala watershed)

In-Progress Funded Projects, Spring 2002

SOUTH FORK

Pacific Watershed Associates: Charles and others SF Gualala Inventory
Sediment Source Inventory
$17,020 funded $18,020 total project cost

BUCKEYE CREEK, WHEATFIELD FORK

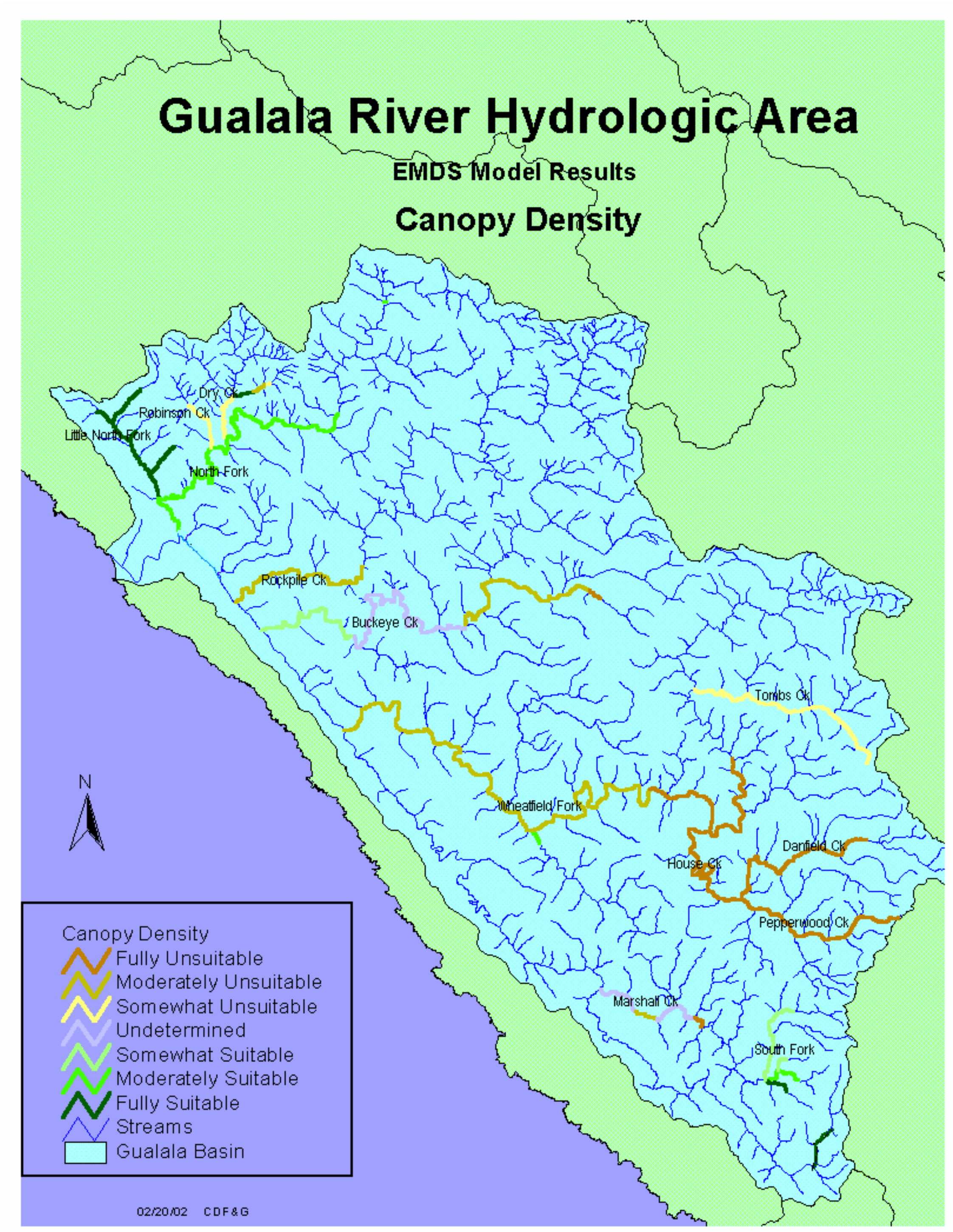
Sotoyome Resource Conservation District: Kelly Road Sediment Source Assessment
Sediment Source Inventory
$18,176 funded $31,276 total project cost

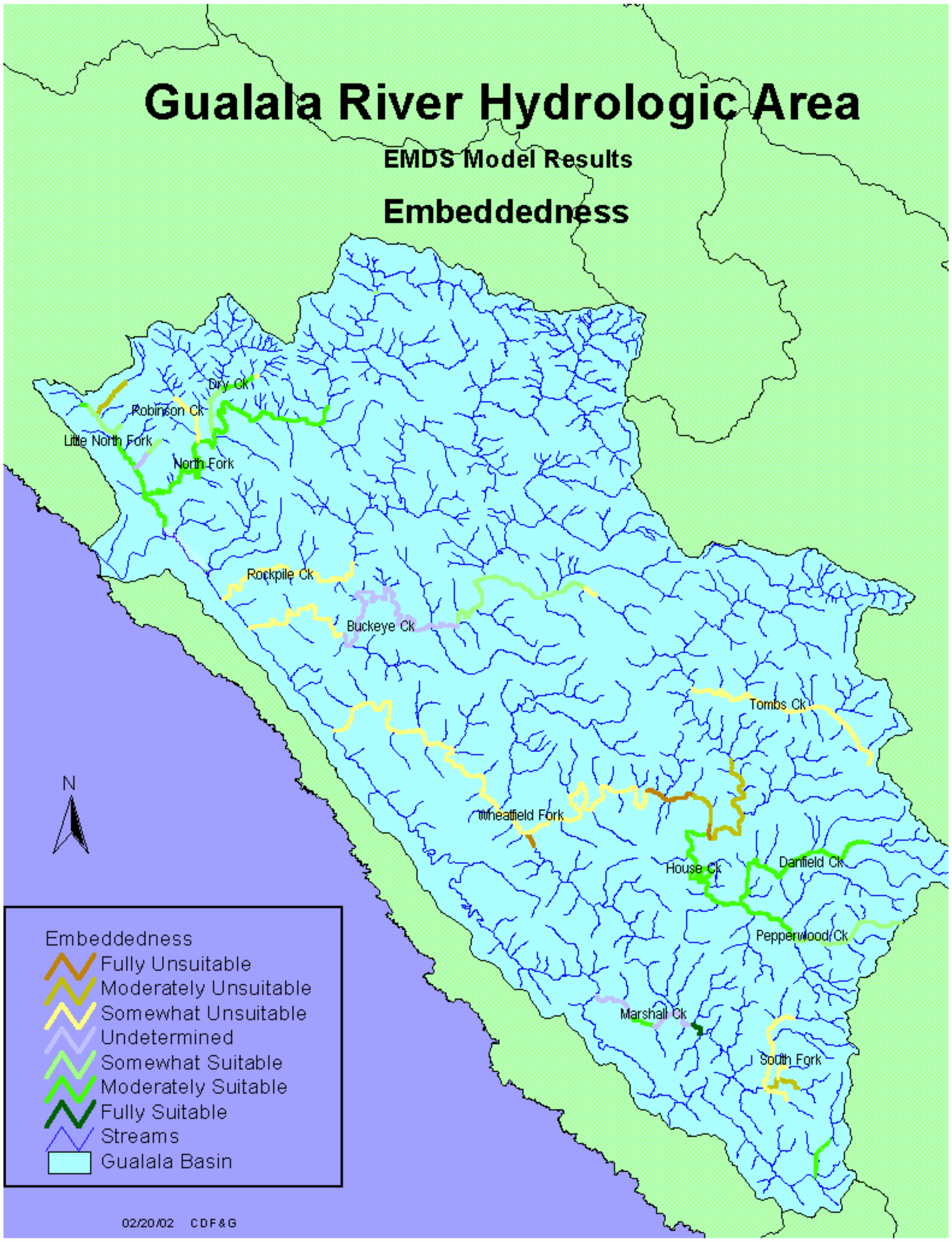
NORTH FORK, ROCKPILE CREEK, BUCKEYE CREEK

Sotoyome Resource Conservation District: Gualala River Wood in the Stream Phase II
Instream Habitat Improvement
$15,461 funded
$38,785 total project cost

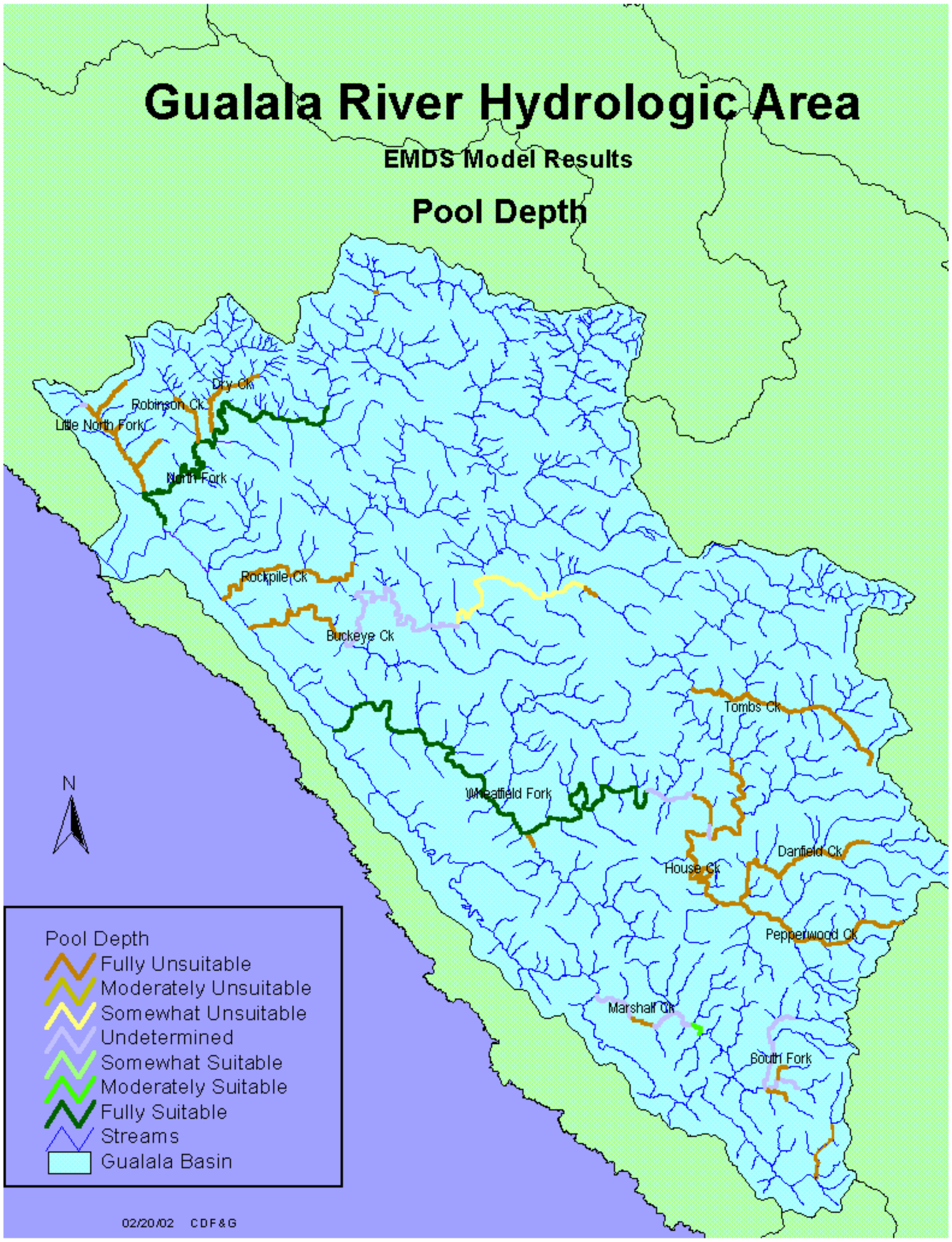
SOUTH FORK (Seaview Ranch area)
Pacific Watershed Associates: McKenzie Creek Watershed Improvement Project
Upslope Sediment Source Remediation
$358,547 funded: $458,547 total project cost

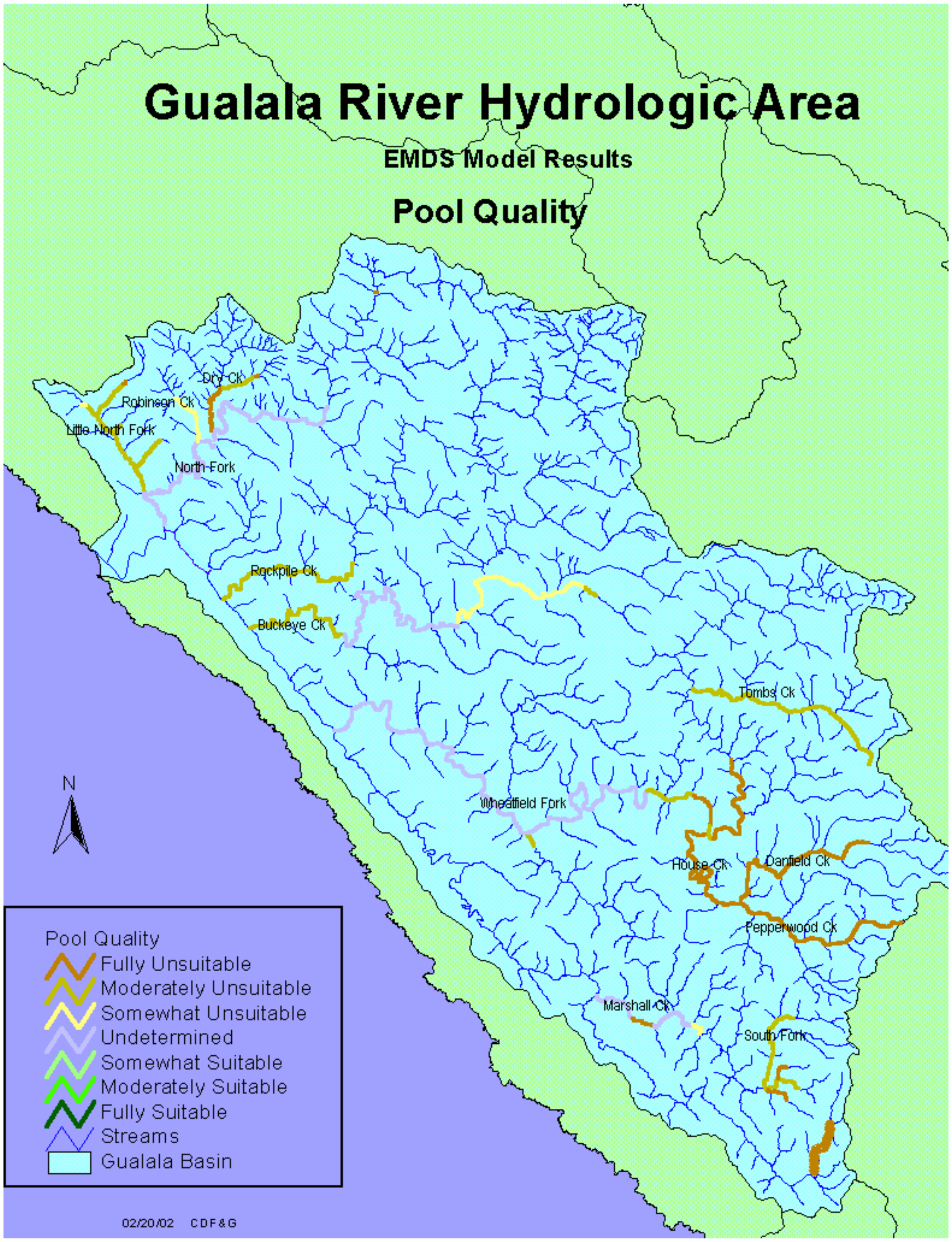
ATTACHMENT I: ECOLOGICAL MANAGEMENT DECISION SUPPORT MAPS

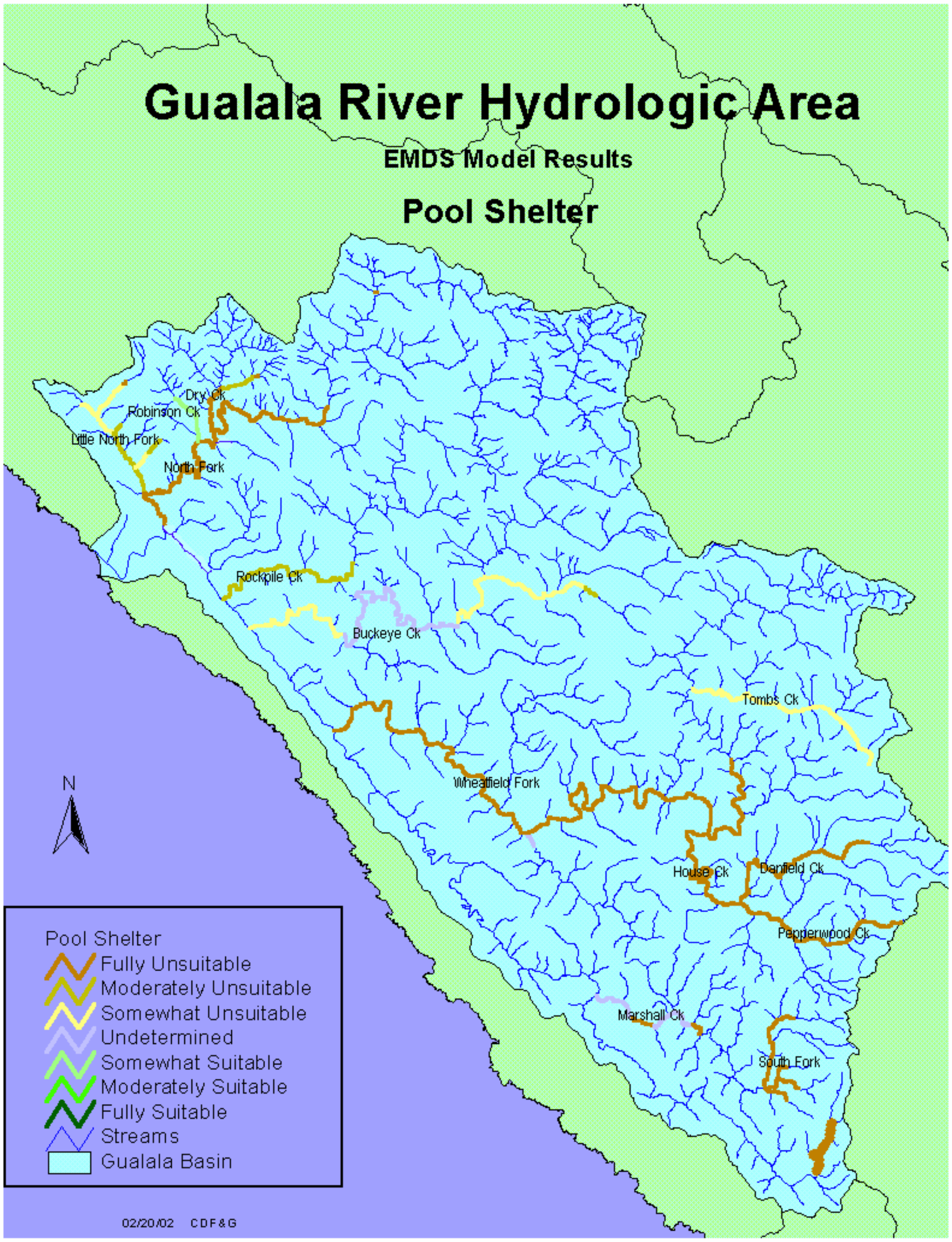


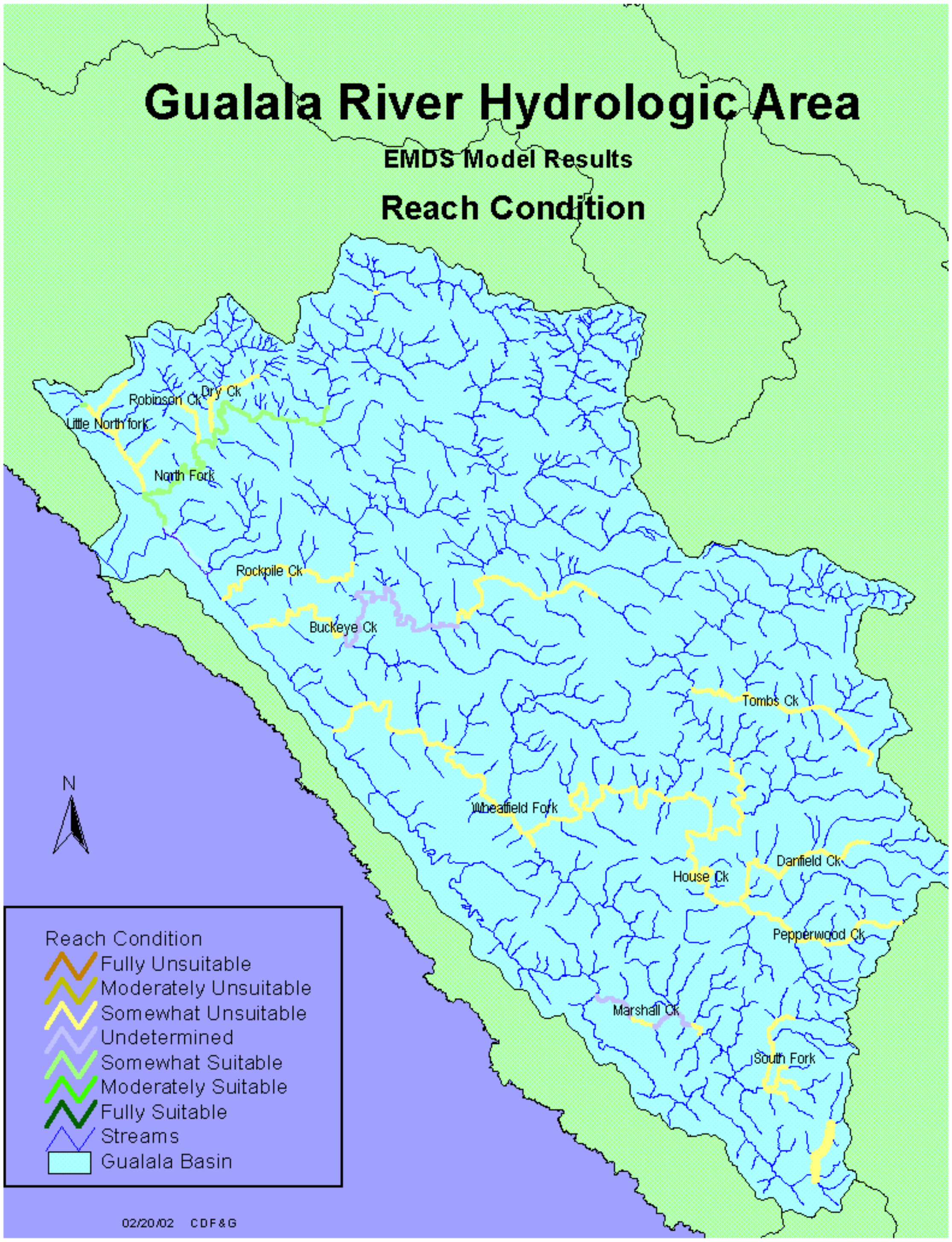

Gualala River Hydrologic Area
EMDS Model Results
Embeddedness
Dry Ck
Robinson Ck
Little North Fork
North Fork
Rockpile Ck
Buckeye Ck
Tombs Ck
Wheatfield Fork
House Ck
Danfield Ck
Pepperwood Ck
Marshall Ck
South Fork
N
Embeddedness
Fully Unsuitable
Moderately Unsuitable
Somewhat Unsuitable
Undetermined
Somewhat Suitable
Moderately Suitable
Fully Suitable
Streams
Gualala Basin
02/20/02 CDF&G

Gualala River Hydrologic Area
EMDS Model Results
In Channel
Dry Ck
Robinson Ck
Little North Fork
North Fork
Rockpile Ck
Buckeye Ck
Tombs Ck
Wheatfield Fork
Danfield Ck
House Ck
Pepperwood Ck
Marshall Ck
South Fork
N
In Channel
Fully Unsuitable
Moderately Unsuitable
Somewhat Unsuitable
Undetermined
Somewhat Suitable
Moderately Suitable
Fully Suitable
Streams
Gualala Basin
02/20/02 CDF&G


Gualala River Hydrologic Area
EMDS Model Results
Pool Depth
Dry Ck
Robinson Ck
Little North Fork
North Fork
Rockpile Ck
Buckeye Ck
Tombs Ck
Wheatfield Fork
Danfield Ck
House Ck
Pepperwood Ck
Marshall Ck
South Fork
N
Pool Depth
Fully Unsuitable
Moderately Unsuitable
Somewhat Unsuitable
Undetermined
Somewhat Suitable
Moderately Suitable
Fully Suitable
Streams
Gualala Basin
02/20/02 CDF&G


Gualala River Hydrologic Area
EMDS Model Results
Pool Quality
Dry Ck
Robinson Ck
Little North Fork
North Fork
Rockpile Ck
Buckeye Ck
Tombs Ck
Wheatfield Fork
House Ck
Danfield Ck
Pepperwood Ck
Marshall Ck
South Fork
N
Pool Quality
Fully Unsuitable
Moderately Unsuitable
Somewhat Unsuitable
Undetermined
Somewhat Suitable
Moderately Suitable
Fully Suitable
Streams
Gualala Basin
02/20/02 CDF&G


Gualala River Hydrologic Area
EMDS Model Results
Pool Shelter
Dry Ck
Robinson Ck
Little North Fork
North Fork
Rockpile Ck
Buckeye Ck
Tombs Ck
Wheatfield Fork
House Ck
Danfield Ck
Pepperwood Ck
Marshall Ck
South Fork
N
Pool Shelter
Fully Unsuitable
Moderately Unsuitable
Somewhat Unsuitable
Undetermined
Somewhat Suitable
Moderately Suitable
Fully Suitable
Streams
Gualala Basin
02/20/02 CDF&G


Gualala River Hydrologic Area
EMDS Model Results
Reach Condition
Robinson Ck
Dry Ck
Little North fork
North Fork
Rockpile Ck
Buckeye Ck
Tombs Ck
Wheatfield Fork
Danfield Ck
House Ck
Pepperwood Ck
Marshall Ck
South Fork
N
Reach Condition
Fully Unsuitable
Moderately Unsuitable
Somewhat Unsuitable
Undetermined
Somewhat Suitable
Moderately Suitable
Fully Suitable
Streams
Gualala Basin
02/20/02 CDF&G